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Coccidæ of Japan, V

S. I. KUWANA
IMPERIAL AGRICULTURAL EXPERIMENT STATION
NISHIGAHARA, TOKYO, JAPAN

I. *Xylococcus napiformis* n. sp.

(Plate I, Figs. 1-9)

Adult female—Napiform, skin smooth and polished; yellowish brown with dark brown codal tubercle. Mouth parts large, rostral setæ long. Antennæ and legs completely wanting. Codal tubercle bears very long white hair-like threads.

Egg—Elliptical, pale pinkish with pink spot. Length, 0.34 mm.; width, 0.17 mm.

First larval stage—Elliptical in form; pinkish purple in color. Antennæ composed of three segments; segment III the longest and bears several rather long hairs. Legs rather slender; femur very short; claw very large and curved; digitules wanting. Lateral margin of abdominal segments with a series of strong spines. Anal opening bears four large rod-like processes. Abdominal end with two very long hairs. Length, 0.40 mm.; width, 0.19 mm.

Habitat—On *Quercus serata*, collected by the writer and others at Nishigahara, Tokyo, and other places of the empire. The body of female is imbedded in the tissues of bark of the host plant and the position of the insect is indicated by a gall-like swelling on the surface. To Mr. T. D. A. Cockerell, the writer is under great obligations for assistance in the determination of the species.

II. *Phenacoccus azaleæ* n. sp.

(Plate II, Figs. 10-12)

Adult female—Elliptical in form, tapering toward the anal end; pale brick to brick in color with the median line paler; legs and antennæ are a little brown; thinly covered with snow-white cottony secretion. Ovisac elongated, sides nearly paralleled,

straight or curved, white, cottony and almost entirely overlapping the body of the insect. Antennæ composed of nine segments, of which segment II is the longest, III a little shorter than II, and VIII the shortest; all the segments hairy; formula of three examples given below:

II, III, (IV, V, IX), (I, VI), (VII, VIII).
II, III, (V, IX), (I, VI, VII), IV, VIII.
II, III, (V, IX), IV, (I, VI), (VII, VIII).

Mouth parts small, the rostral setæ rather short. Legs subequal; tibia three times as long as the tarsus; claw strong and curved with teeth in the inner margin; digitules of tarsus slender while those of the claw short and stout. Derm thick, set with fine hairs and numerous simple spinnerets. Anal lobes indicated by a long hair and several short spiny hairs, and there is a conspicuous group of spinnerets surrounding the base of the hair. Anal opening with six prominent hairs.

Length, 3 to 3.5 mm.; width, 2 to 2.5 mm.; ovisac, 6 to 12 mm.

Egg—Oblong in form; pale lemon in color. Length about 0.25 mm; width, 0.11 mm.

First larval stage—Oval in outline; yellowish in color; eyes red and prominent. Antennæ six-segmented, segment VI as long or even longer than the three preceding segments together. Mouth parts very large. Legs large; tibia and tarsus about equal in length. Side of the body with a series of spines. Front of the head between antennæ with two hairs. Anal lobes with one long hair and one short spine. Length, 0.3 mm.; width, 0.15 mm.

Habitat—This new species lives on small branches and underside of leaves of azalea. It is closely allied to *Phenacoccus pergandei* Ckll., from which it may be separated at once by the smaller size.

III. *Eriococcus festucæ* Kuwana et Fukaya (n. sp.)

(Plate II, Figs. 13-14).

Ovisac of female—Closely felted and tough; pale straw or white in color; elongated, convex, with many inconspicuous

transverse ridges; codal extremity with a small opening. Length, 3.5 mm.; width, 1.3 mm.

Adult female—Elongate in form; pale yellow in color, after treatment with KOH turned light pink. Derm with numerous strong spines and many fine slender hairs and a small circular cells. Lateral margin of abdomen with a series of very strong spines which are very much stronger than those on the derm. Mouth parts small; rostral setæ short. Antennæ short, composed of six or seven segments; last few segments bear many long hairs; formula of two examples given below:

Six-segmented antennæ ..... III, II, VI, I, (IV, V).
Seven-segmented antennæ ..... IV, III, VII, II, I, VI, V.

Legs stout; tarsus slightly longer than tibia. Anal ring with eight prominent hairs. Abdominal lobes normal; each with one long and two or more short spines. Length, 2.0 mm.; width, 1.1 mm.

Egg—Elliptical, lemon in color. Length, 0.3 mm.

Habitat—On *Fistica parvigluma*, Nishigahara, Tokyo. Collected by C. Fukaya of this station, June, 1910. This new species is closely allied to *Friococcus insignis* Newst. and also *E. greeni* Newst., from which it may be distinguished by arrangement of spines of abdominal segments.

IV. *Pulvinaria citricola* n. sp.

(Plate II, Figs. 15-19)

Adult female—Oblong oval in form, moderately convex above; pale olive in the color with yellowish dorsal line; shrivelling after gestation and flavus with dark irregular lines near the margin. Ovisac snow white, rather long with two conspicuous dorsal ridges to form a deep median furrow. Antennæ composed of eight segments; segment III the longest and VII the shortest; the last segment with many long hairs: formula, III, IV, (II, VIII), (I, V), (VI, VII). Mouth parts small; rostral setæ short. Legs subequal, short and stout; tarsus one-half the length of tibia; claw short and curved; digitules usual. Marginal hairs simple but occasionally divided. Stigmatic

indentation not well defined, with three stout hairs of which the median long with two short. Anal cleft shallow. Triangular plates large; the inner edge the longest, base almost equal with outer edge, apex with several strong hairs.

Length about 4 mm.; width, 2.5 mm.; ovisac about 4-7 mm.; body with ovisac about 9 mm.

Egg—Oblong, white. Length about 0.28 mm.; width about 0.17 mm.

First larval stage—Oval in form, pale in color. Length about 0.38 mm.; width, 0.24 mm.

Habitat—On citrus in Okayama, Shizuoka and on Persimmon (*Diospyros kaki*), *Hibiscus syriacus,* citrus and other plants in Tokyo. One generation a year and very injurious to citrus in Shizuoka and Okayama. It is closely allied to *Pulvinaria cellulosa* Green.

V. *Pulvinaria photiniæ* n. sp.

(Plate II, Figs. 20-24)

Adult female—Elliptical in form, convex; grayish black with yellowish-brown marking on the dorsal line; more or less covered with white cottony secretion. Ovisac white, rather firm in texture, long, two well-marked longitudinal ridges with many cross ridges. Antennæ with eight segments; usually segment III the longest, sometimes III and IV are almost equal in length; formula of two examples given below:

III, IV, II, (V, VIII), I, VI, VII.
III, IV, (II, VIII), (V, I), VI, VII.

Mouth parts well formed, rostral setæ very short. Legs stout, short and subequal with few hairs; coxa very large, femur longer than tarsus; tarsus slightly longer than one-half length of tibia; claw large, curved; digitules normal. Marginal hairs short and simple. Stigmatic indentation shallow with three strong spines, of which the median one very long while other two shorter than the marginal hairs. Derm crowded with many round cells. Triangular plates broad; base about equal with

outer edge; together approximately quadrate; apex of the plate with five hairs.

Length, 5-6 mm.; width about 4 mm.; ovisac, 6-9 mm.

Egg—Oblong, very pale yellow. Length, 0.27 mm.; width, 0.15 mm.

First larval stage—Oval and flat; pale yellow, eyes dark purple. Antennæ six-segmented; the last segment the longest. Length about 0.30 mm.

Habitat—On *Photonia villosa,* and *Celtis sinensis,* Nishigahara, Tokyo. Collected by the writer and others, May, 1912.

VI. *Pulvinaria okitsuensis* n. sp.

(Plate III, Figs. 25-29)

Adult female—Lemon yellow in color, derm slightly powdered with white mealy secretion. Elliptical in form, slightly convex; derm soft, shrivelling after gestation. Ovisac white, elongated, straight or curved. Antennæ composed of seven or eight segments, usually eight; in the former, segment IV the longest, while in the latter case, segment III the longest; each segment with long slender hairs; formula of two examples given below:

IV, III, II, VII, I, V, VI.
III, II, VIII, IV, V, (VI, VII, I).

Mouth parts small and stout; rostral setæ short. Legs subequal; coxa large and much longer than wide, with several short hairs; trochanter small and slender, with one long and one short hair; tarsus longer than one-half the length of tibia; claw stout, curved; digitules on tarsus rather short and stout, while those on the claw very stout. Marginal hairs slightly dilated or simple. Stigmatic indentation not well defined, with three stout spines, those of the middle one very long, while the other two are very short, shorter than the marginal hairs. Derm crowded with irregularly oval or round cells. Triangular plates small, together approximately square; base equal to outer edge; outer angle rectangular; apex with several hairs; two prominent hairs on about the middle of the plates.

Length about 2-3 mm.; width, 2 mm.; ovisac, 5-9 mm.

Egg—Oblong and white; length about 0.27 mm; width, 0.16 mm.

First larval stage—Oval in outline; pale yellow in color, with eyes black. Antennæ six-segmented, segment III the longest.

Habitat—On orange, in Okitsu, Shizuoka-Ken. Collected by the writer, May, 1912.

This new species is allied to *Pulvinaria thespesiæ* Green, but much smaller and distinguished by the shape of the triangular plates; in this species the outer angle of the triangular plate is irregular, while that in *P. thespesiæ* is broadly rounded. Differs also in the relative length of antennal segments.

VII. *Pulvinaria idesiæ* n. sp.

(Plate III, Figs. 30-35)

Adult female—Dark green with yellow marking; oval or nearly round, slightly convex, derm soft, shrivelling after gestation. Ovisac white, with a deep median longitudinal groove and many cross ridges. Antennæ usually eight-segmented, but seldom only seven; segment III the longest; all segments bear rather long hairs; formula of four examples as follows:

III, (II, IV), V, VIII, VI, (VII, I).
III, II, IV, V, (VI, VIII), I, VII.
III, II, (IV, V), (VI, VIII), I, VII.
III, II, IV, V, VI, VII, I.

Mouth parts well formed; rostral setæ rather long. Legs stout, subequal; coxa much longer than wide; trochanter with one long and few short hairs; femur about equal with tibia in length; tarsus shorter than one-half of tibia; claw short and curved; digitules rather short. Marginal hairs simple; stigmatic cleft shallow with three usual spines, of which the median one is very long. Derm with scattered small circular cells. Triangular plates very prominent; inner edge longest; base and outer edge about equal; apex bluntly pointed; outer edge slightly curved; apex with several spines.

Diameter about 4-7 mm.; length with ovisac, 8-10 mm.; ovisac, 4-6 mm.

Egg—Oblong, pale yellow. Length about 0.35 mm.; width, 0.16 mm.

First larval stage—Elliptical, pale yellow with red eyes. Length about 0.20 mm.; width, 0.11 mm.

Habitat—On *Idesia polycarpa*, and *Phellodendron amurensis*, Nishigahara, Tokyo. Collected by the writer and others, May, 1911. This new species is allied to *Pulvinaria horii* Kuw. but much smaller in size.

VIII. *Lecanium* (*Eulecanium*) *pseudomagnoliarum* n. sp.
(Plate III, Figs. 36-39)

Adult female—Elongated oval, slightly convex; dark olive in color with dark brown dots. Antennæ composed of eight segments; segment III the longest, but only a little longer than IV; the terminal segment bears many long hairs; formula, III, (VIII, IV), V, II, VI, VII, I. Mouth parts small but well formed; rostral setæ short. Legs small and alike; tarsus about three-fourths length of tibia; claw small, curved and sharp; digitules usual. Stigmatic indentation not well defined, with three usual spines, the median one more than twice as long as the others. Triangular plates together near square; base and outer edge almost equal; three spines near apex.

Egg—Oval, pale yellow; length about 0.26 mm.; width, 0.11 mm.

First larval stage—Oval, pale yellow in color with black eyes. Antennæ six-segmented.

Habitat—On citrus in Tokyo and Shizuoka, found by the writer and others, May, 1912. This new species is allied to *Lecanium* (*Eulecanium*) *magnoliarum*, but much smaller and quite different in the antennal formula and the shape of triangular plates as shown in the figures.

IX. *Lecanium* (*Eulecanium*) *magnoliarum* Ckll.

On *Berberis nepalensis* (Hiiragi-Nanten) in Tokyo and on grape vine in Shizuoka-Ken. Collected by C. Fukaya and K. Yoshida, May, 1912. This is the first time that the writer has seen the species in Japan.

(Nishigahara, Tokyo, Japan, May, 31, 1913).

EXPLANATION OF PLATES

PLATE I.

Xylococcus napiformis n. sp.

Figure 1. Infested twig of *Quercus serata.*
Figure 2. Adult females.
Figure 3. Section of a twig showing that the female is imbedded in the tissues of bark of the host.
Figure 4. Abdominal end of female.
Figure 5. Eggs taken out of the female body.
Figure 6. First larval stage.
Figure 7. Antennæ of the same.
Figure 8. Abdominal end of the same.
Figure 9. Leg of the same.

PLATE II.

Phenacoccus azaleae n. sp.

Figure 10. Antennæ of adult female.
Figure 11. Leg of the same.
Figure 12. Claw of the same.

Eriococcus festucae Kuwana and Fukaya, (n. sp.)

Figure 13. Antennæ of female.
Figure 14. Marginal spines of the same.

Pulvinaria citricola n. sp.

Figure 15. Antennæ of female.
Figure 16. Marginal hairs and stigmatic spines of the same.
Figure 17. Triangular plates of the same.
Figure 18. Leg of the same.
Figure 19. Claw of the same.

Pulvinaria photiniae

Figure 20. Antenna of female.
Figure 21. Stigmatic spines of the same.
Figure 22. Marginal spines of the same.
Figure 23. Leg of the same.
Figure 24. Claw of the same.

PLATE III.

Pulvinaria okitsuensis n. sp.

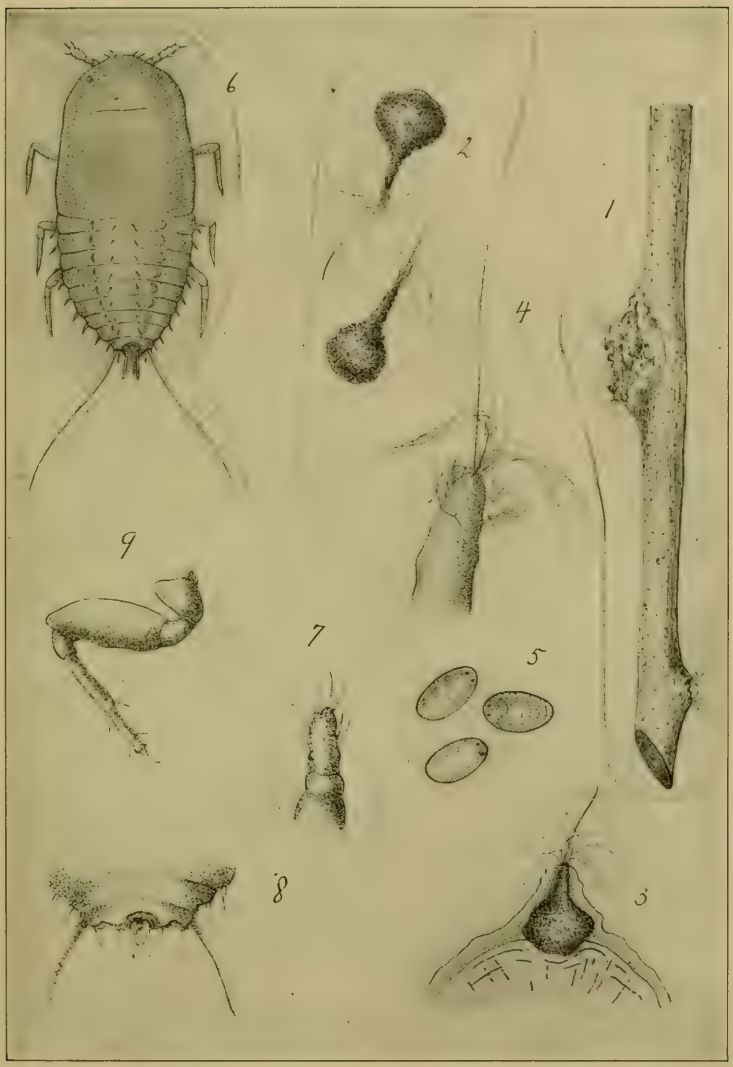
Figure 25. Antenna of female with seven segments.
Figure 26. The same with eight segments.
Figure 27. Leg of the same.
Figure 28. Stigmatic spines and marginal hairs of the same.
Figure 29. Triangular plate of the same.

Pulvinaria idesiae n. sp.

Figure 30. Antenna of female.
Figure 31. Leg of the same.
Figure 32. Claw of the same.
Figure 33. Stigmatic spines of the same.
Figure 34. Marginal hairs of the same.
Figure 35. Triangular plates of the same.

Lecanium pseudomagnoliarum n. sp.

Figure 36. Antenna of female.
Figure 37. Leg of the same.
Figure 38. Claw of the same.
Figure 39. Stigmatic spines and marginal hairs of the same.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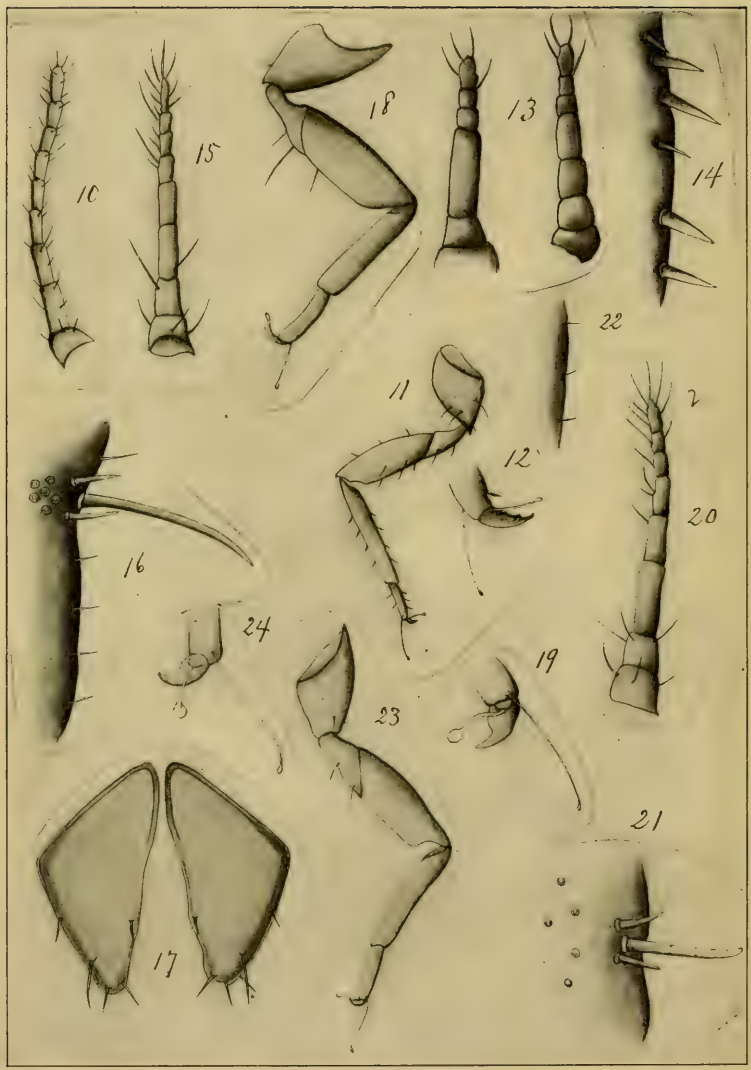
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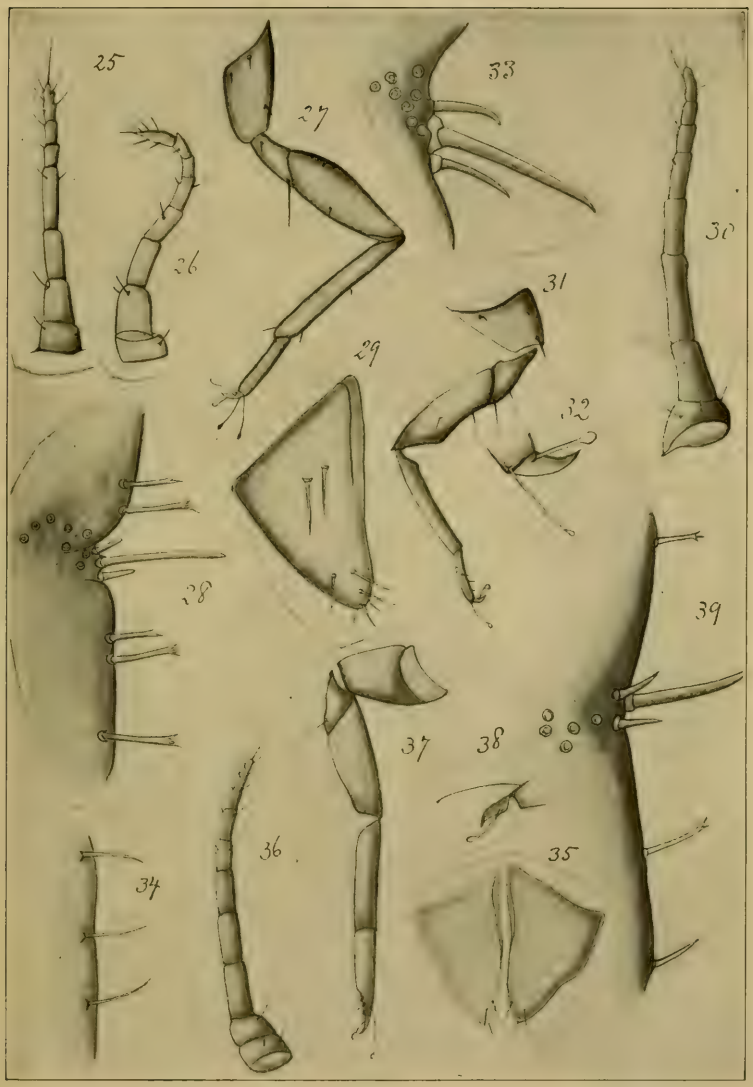
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The Biology of the North American Crane-Flies (*Tipulidæ, Diptera*)

I. THE GENUS *ERIOCERA* MACQUART

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Introduction

The tribe *Hexatomini,* one of the ten sections into which the Tipulid flies have been divided, is widely distributed in the north temperate and torrid zones. The dominant genus is *Eriocera,* containing nearly one hundred described species, most of which are tropical forms. No species have been described from Europe or the Australian region but elsewhere the genus is represented by a host of forms, the number of species becoming less as one goes north or south from the equator. The males of many of the species have the antennæ exceedingiy elongated, extending backward twice the length of the body. The wing-coloration in the northern forms is sober, undiversified, but in the tropics the wings of many species take on a banded or spotted appearance that is quite unparalleled in any other group of crane-flies.

The immature stages of this remarkable group of insects were quite unknown hitherto. Van Roser (Verzeich.-Wuerttemberg. Dipt., pt. 1, p. 262) states that the larvæ of *Hexatoma* (=*Anisomera* of authors) live in the sand along the banks of streams.

The members of this tribe of insects seem to be easily recognized in all stages. The adult flies, although closely resembling the *Limnophilini* in venation, have the minimum number of antennal segments for the family, there being but six of these segments in *Hexatoma* and not more than ten elsewhere in the

*Contribution from the Entomological Laboratory of Cornell University.

tribe. Other crane-flies have, as a rule, thirteen, fourteen or sixteen segments to the antennæ. The pupæ of the *Hexatomini* differ from all crane-fly pupæ known to the authors in the presence of six pairs of abdominal spiracles. The larvæ, in the powerful decussate mandibles, the great elongation of the maxillæ and the feeble chitinization of the mental region present striking differences from other crane-fly larvæ.

Larval habitat—The larvæ and pupæ of the three forms reared occurred together in a gravelly sand-bank along Fall Creek near Forest Home, Ithaca, N. Y. The soil in which the species occurred varied from a gravel of rather coarse texture to a fine clay thickly penetrated by grass-roots. Earlier in the spring, full grown larvæ of *E. spinosa* have been found in Fall Creek, Coy Glen and other rapid streams about Ithaca, at which time they occurred beneath stones far out in the bed of the creek. It seems probable that most of the larvæ live in sand near the water's edge; that many could live beneath stones in the creek seems impossible considering the closeness of search by members of the Limnological classes during the past few years.

On the morning of April 30, 1913, Mr. Lloyd found adults of *E. longicornis* very common on the island in Fall Creek above the second bridge in Forest Home. They were swarming in numbers around the flowers of Willow (*Salix*), that grows commonly on the flat shore. On the morning of May 1, Dr. Needham and Mr. Alexander went up to this island to observe the feeding habits of the species. Very few of the adult flies were to be seen on the wing but the insect was emerging by the hundred, and pupæ, cast pupal skins and teneral adults were very common. The pupæ of *longicornis* occurred an inch or two beneath the surface of the gravel, projecting from one-third to one-half of their length above the soil level, the caudal end attached. A few specimens pushed up about two-thirds of their lengths and remained perfectly quiet in the hot sun, settling lower and lower in their cavities until almost hidden; it seems probable that such specimens would not transform as strong, healthy individuals even if they emerged at all. Most

of the pupæ project about half their length from the soil and, attached by the caudal end, sway back and forth rather actively. In none was the beginning of transformation observed; specimens partly out of the skin were several times noted. The male has difficulty in extricating the very long antennæ from the pupal sheath. A field sketch made of the closely-allied *E. spinosa* is herein given and shows the relative position of the

Adult male of *Eriocera spinosa* O. S. emerging from the pupal skin. The coloring and hair-characters are from a fully colored adult.

parts of the body that are used: the first flagellar segment of the antennæ is directed straight away from the body, the fourth segment (second flagellar) at an acute angle to the third and thence the antennæ continue straight back to the sheath. The numerous spines on the underside of the flagellum of the males of *E. spinosa* and *longicornis* have long been known and the fact that they pointed away from the body noted; any use for this curious development has not been suggested. We observed the males in the act of withdrawing their antennæ and the method of procedure was about as follows: The tips of the fore femora are placed underneath the sharp spines on the flagellum and by raising the leg the antenna is pulled upward slightly. These spines are regularly arranged and since both forelegs work in unison, the spines function as cogs and the whole organ is gradually forced from its pupal sheath. The

whole body is carried very straight and stiff during this operation, the abdomen, especially, being very long and pale. The drawing out of the extreme tips of the antennæ is usually accomplished by the bending backward of the whole body of the insect, but this is not always the case. When the antennæ are freed, the insect then walks a few steps from the skin, first withdrawing its abdomen from the case. It then waits quietly until it attains more strength and color. It is probable that this teneral condition of the insect is its most dangerous period as it is defenseless against all enemies. An account of the enemies of the species is given in a later paragraph.

A count of one square foot of normal gravel was made at this time and showed the following: Twenty-eight living pupæ of *longicornis,* two larvæ of *spinosa,* one pupa of *Tipula bella* Lw., one large Tabanid larva; forty-seven cast pupal skins of *longicornis,* as well as most of the natural beetle associates given in a later place. This infestation was merely normal and many square rods of ground along the south bank of Fall Creek were in almost the same condition. One small larva, almost certainly of this species and described hereinafter as such, was found but practically all of the larvæ had passed into the pupal stage; many of these pupæ were very pale and feebly colored and evidently but newly transformed.

The emergence of the adults of *E. longicornis* from the pupæ took place during the late hours of the morning, most numerously between ten a. m. and noon.

Natural enemies of the pupæ and the teneral imagoes were found to be medium-sized black *Lycosid* spiders which were preying on the weak, uncolored adults in numbers; dozens of the spiders were noted with individuals of the crane-flies in their grasp; these spiders when alarmed would run away very rapidly but only in exceptional cases would they release their victims. A few *Attid* spiders were also noted with Erioceræ. A mound of gravel and sand containing many pupæ and skins was noted showing traces of a bird or mammal having preyed upon the pupæ.

Natural associates of *Eriocera* on these gravel beds were ground-beetles of the genera *Omophron, Schizogenius, Dyschirius, Bembidium* and *Agonoderus;* click beetles, *Cryptohypnus,* and rove-beetles, of which *Pæderus, Lathrobium* and *Cryptobium* were the commonest forms. A large larva of *Corydalis* about ready to pupate and an abundance of larvæ and pupæ of horse-flies, *Tabanidæ,* were taken.

The larvæ of *E. spinosa* were found in great numbers in these gravel-banks on May 1. They occurred with young and mature pupæ of *E. longicornis* which were emerging in great numbers at this time. On May 27, both larvæ and pupæ of *spinosa* were found to be very abundant, larvæ being more numerous in the wetter places, pupæ in the dryer spots. They occurred at various distances from the water's edge, from within a foot to as far back as eight or ten feet from the shore. The pupæ occur in short, more or less vertical burrows, from one to three inches below the surface. Not often were larvæ and pupæ found in close proximity to one another. Pupæ of *spinosa,* as well as all others of the tribe so far as known, are very active when removed from their burrows, wriggling rapidly to and fro, and are exceedingly tenacious of life. Larvæ, as found on May 27, were mostly contracted; a few, however, were expanded and had the subterminal segment of the abdomen swollen. In this regard it may be mentioned that almost all of the larvæ of crane-flies that live in the sand or mud along stream banks, have this power of inflating the end of the abdomen. Larvæ of *Eriopterini, Limnophilini, Pedicini* and *Hexatomini* have been observed with this conspicuous enlargement. It is apparently used to propel the larva through the soil by alternate expansion and contraction of the segment.

Larvæ of this species were placed in breeding-jars on May 13, and adult flies emerged on the 28th. It is probable that the pupal stage is not longer than ten to twelve days, but this was undoubtedly accelerated by the increased warmth of the laboratory. The natural pupal period may be as long as two weeks. On May 30, a large number of larvæ and pupæ were brought into the laboratory in a bucket of gravel. Some of the

fully-grown pupæ transformed in the pail while being brought into the laboratory. The larvæ are almost certainly carnivorous, their powerful sickle-shaped mandibles inflicting a painful bite on tender parts of the hand.

The larvæ of *E. fultonensis* were found in the same situations on May 30. They occurred in company with numerous *spinosa* larvæ and pupæ, a few large Tabanid larvæ, a small Tabanid pupa, and the following beetle associates: *Bembidium, Schizogenius, Tachys, Cryptobium bicolor, etc.* These larvæ were placed in breeding-jars on May 30. One of these larvæ pupated on June 1 and emerged as an adult on June 6. This gives a very short indoor pupal period of a trifle less than a week.

The habits of the adult flies are still not well known. At 5:00 p. m. on May 1, 1913, the swarming of the species was observed near the place described above. At 5:40 p. m. they were flying in some numbers, swarms averaging from thirty to forty individuals being the most common. They kept out in the open, away from trees or bushes, and maintained an average height of from thirty to forty feet above the ground. Most of the swarms were out above the creek-bed but others were above the banks of the stream. The entire swarm seemed to face the gentle easterly breeze (i. e., up-stream). They swarmed about on a horizontal plane, the motions of each individual being mostly like a figure 8. The swarm covered considerable space, being from eight to ten feet high and about one-half of that distance through, the swarm scarcely moving from its position. Individuals constantly leave and rejoin the swarms. The insects sit on the tops of the willow bushes before joining the swarms and at this time are very wary. They dart up into the air and far overhead at the first approach of a possible enemy. It is very hard to catch specimens from the ground, but by standing on the bridge, which is only a little lower than the level of the swarm, it is rather easy to capture departing and incoming individuals. The next night, May 2, at 5:30 p. m., the insects were again swarming in numbers; at this time the swarms were smaller, of from twenty-five to thirty individuals, and they swarmed quite low, ten to fifteen feet up, just out

of reach of a net. The motion of individual specimens in a swarm varies at different times, now being a slow 8, now fast. One or two seemed to copulate in midair; this was done so rapidly, however, that it is not certain, the more so as it is so different from the mating habits of the closely-related *Hexatoma*.

The rearing of this material to the adult stage was accomplished by Mr. Lloyd; the biological notes herein given, the technical descriptions and the figures are by Mr. Alexander.

We wish to express our sincere thanks for the kind help and advice given to us by Dr. Needham during the progress of this study.

Description of the Species

Common characters of the larvæ—The body is rather stout, yellowish, with a conspicuous bronzy sheen. The head-capsule (plate I, figure A) is long and narrow, and when retracted is completely concealed in the first thoracic segment, only the tips of the long apical maxillary lobe projecting. The mandibles are long, acutely pointed, decussate, provided with teeth on the inner basal half (a). One of the lobes of the maxillæ (c) is prolonged cephalad in a long, flat, blade-like appendage. The antennæ (b) are rather long, cylindrical. The framework of the head consists of a broad plate on either side in front, herein described as the genal plate (e), and two long bars of chitin extending backward on either side, one of these bars occupying a dorsal position, the other constituting the lateral margin of the capsule. The entire mental region seems to lack chitinized parts. The cauda (plate I, figures I-L) has the stigmal field free from lobes in *longicornis* or with four lobes in the other species.

Common characters of the pupæ—The head is provided with a group of lobes herein spoken of as the cephalic crest (plate II, figure A, a). Spines or tubercles occur in the different species on the scape of the antenna, the tentorium, the clypeus, the eye, the thoracic scutellum, etc. Pronotal breathing-horns short, cylindrical (*longicornis*), long, cylindrical (*fultonensis*)

or acute and curving ventrad at apex (*spinosa*). Segments II to VII of the abdomen with a spiracle on either side.

Key to the Larvæ of Eriocera

1. Head capsule long and narrow; lateral lobes of the fronto-labral sclerite not pronounced; labrum small. Caudal lobes not developed; hairs around the stigmal field very few (about twenty) but very long. (Genal plate produced into a lobe on the inner cephalic angle; a strong conical tooth on inner face of mandible at about midlength.)
longicornis Walk.

   Head capsule broader; lateral lobes of the fronto-labral sclerite prominent; labrum well developed. Caudal lobes prominent, one pair being lateral and one pair ventral, bearing fringes of abundant long hairs. 2

2. Large larvæ (fully grown and extended, 40-45 mm. long, and 4-5 mm. in diameter); lateral lobes of fronto-labral sclerite not hairy; tubercles on labrum merely rounded; no strong, truncated tooth at mid-length of the mandible on the ventral face; hairs on caudal lobes prominent, reddish. Lateral lobe with a black line which is conspicuously enlarged at its inner end; ventral lobes with a black line which is forked, Y-shaped, at its inner end.
spinosa O. S.

   Smaller, more slender larvæ (fully grown and extended, 18-26 mm. long, 2 mm. in diameter); lateral lobes of the fronto-labral sclerite clothed with abundant long hairs; tubercles on labrum cylindrical, truncated, chitinized; a strong, truncated tooth at mid-length of the mandible with a smaller one beside it; hairs on caudal lobes abundant but pale, indistinct. Lateral lobe with a black line which is not conspicuously enlarged at its inner end; ventral lobes with a black line which is enlarged at its inner end, not conspicuously forked.
fultonensis Alex.

Key to the Pupæ of Eriocera

1. Size large (length 25 mm. or over); pronotal breathing horns tapering to the acute tip; cephalic crest small, reduced to four tubercles; cell M_1 on wing-pad present and usually evident; a strong spinous tubercle on either side of the median line at the base of the second abdominal tergite; a tubercle on the eye. (Mesonotal scutellar lobe, conspicuous, projecting). *spinosa* O. S.

   Size small (length under 18 mm.); pronotal breathing horns about uniform in diameter throughout their length, blunt at apex; cephalic crest prominent, in some species so large as to conceal from beneath the pronotal breathing horns; cell M_1 on wing-pad absent; no spinous tubercle at base of second abdominal tergite; no tubercle on eye.[2]

2. Antennæ of ♂ elongate, reaching almost to the tip of the wing-pad; lobes of the cephalic crest triangular, rather pointed at the apex, the lobes when viewed from beneath, tending to diverge apically; pronotal breathing horns short, not much longer than a single lobe of the crest; median scutellar lobe conspicuous, projecting; hind tarsi projecting considerably beyond the level of the inner two; wing-pads usually showing cross-vein *r* beyond the fork of R_2+_3; spine on antennal scape present. *longicornis* Walk.

   Antennæ of ♂ short like the ♀, reaching just beyond the base of the wing-pad; lobes of the cephalic crest more rounded, thickly covered with rounded protuberances, the lobes when viewed from beneath, tending to converge apically; pronotal breathing horns long, exceeding the whole crest in length; median scutellar lobe not apparent; all the tarsi about on a level; wing-pads pale, showing cross-vein *r* before the fork of R_2+_3; spine on antennal scape absent. *fultonensis* Alex.

ERIOCERA LONGICORNIS Walker

1848 *Anisomera longicornis* Walker; List Dipt. Brit. Mus.; vol. I, p. 82.

LARVA

Length, not fully extended, 13-13.5 mm.; diameter, 2 mm.; at subterminal swelling, 2.4 mm.

Color of larva light yellowish; almost uniformly cylindrical; the prothorax a little shorter than the other two thoracic segments; first abdominal segment simple, a little shorter than the metathorax; remaining abdominal segments with a faint basal constriction, dividing the segment into two annulets; remaining segments gradually increasing in length toward the end; the tenth segment is capable of being enormously distended; the last segment is narrowed, tapering to an obtuse point; this segment is clothed with numerous appressed hairs and two or three long, delicate hairs on the side of the segment.

Head-capsule long and narrow, measuring 1.5 by .275 mm. On the antero-dorsal portion of the head-capsule are the two genal plates (Snodgrass terminology), these rather broad, separated from one another along the dorsal median line by a wide space; the cephalic inner angles produced entad into prominent lobes (plate I, E), the caudal margin of the plates produced caudad in a fringe-like comb of chitinized points; these genal plates (which presumably include the vertex and genæ) are only about two-fifths the length of the head-capsule. Cephalad of the genal plates is a rounded median lobe (frons and clypeus) bearing at its apex a few small tubercles and a small quadrate projection (labrum); the lateral margins of this sclerite are gently rounded, not produced cephalad into prominent lobes. This plate consists of the fused frons, clypeus and labrum. Laterad of the genal plate is an elongate chitinized piece articulated with the base of the mandible on its dorso-lateral aspect, fused or closely applied to the genal plates for most of the length of the latter, thence articulated end-to-end with another elongated bar of chitin which extends caudad, expanding out at its tip and becoming approximated with its

fellow of the opposite side on the dorso-median line. This bar and the genal plates form the dorsal framework of the head-capsule. From the ventro-lateral angle of the mandible there arises another long bar of chitin which runs caudad ending about on a level with the median dorsal bar, very little expanded at its tip; this bar forms the lateral framework of the head-capsule. *Antennæ* (plate I, C, b) arising on the inner cephalic angle of the genal plate just dorsad of the base of the mandible. It consists of a one-segmented, cylindrical, slightly curved organ which bears a number of long hairs at its apex, almost as long as the segment itself. *Mandibles* (plate I, H) exceedingly powerful, decussate, ending in a long, sharp point, on its caudal or inner face bearing a prominent conical tooth at about mid-length, and with other blunt protuberances nearer the base; one of the ventral strands of muscle has an egg-shaped, chitinized piece isolated in it. *Maxilla* arising just ventrad of the mandibular base, articulated on its outer caudal angle with the lateral chitinized bar of the head; the palpus is very short, lying underneath the base of the mandible, short-cylindrical, ending in a small cylindrical tip which is enclosed in a rounded fleshy apex; one of the two apical lobes of the maxilla (galea or lacinia) persists as a very elongate, pale, blade-like organ projecting far beyond the other mouth-parts, on the cephalic inner face with a long supporting strand of chitin which is forked near the base. *Mental region* entirely lacking strongly chitinized parts, the only indication of chitinization being a pale yellow area continued from the tips of the mandibles caudad but completely disappearing in caustic potash (1% solution, 24 hours).

Stigmal field small, oval, at the caudal end of the body, the stigmata occupying the dorsal portion of the area (plate I, K, L). Stigmata small, oval, placed rather obliquely, their dorsal ends directed inward, the distance between them less than the length of one or about equal to the small diameter of one. A faint dusky mark from the dorsal margin of each stigma to the edge of the field; a faint vertical stripe lying between the stigmata. There are no distinct lobes around the

stigmal field; at about midlength and lying on the lateral margin of the field is an elongate triangular black mark, its point directed outward; from this point and the margin of the field just above its tip, arise three long curved hairs directed outward. The ventral marks are larger, brownish black, these marks three-pointed at their dorsal end, the innermost of these points connected with its fellow of the opposite side; just laterad of this mark is a slender brown line which bears at regular intervals, three long, slender, curved hairs directed caudad; at the caudal margin of the large mark arise three very large hairs directed ventrad and arising from a common point so that they appear coalesced at their origin. Just laterad of these three bristles is still another delicate hair; so that surrounding the stigmal area there are about twenty of these long hairs. Caudal gills four, very short and inconspicuous, hidden underneath the subterminal enlargement.

Described from one larva taken in company with abundant pupæ of the same species, Forest Home, Ithaca, New York, May 1, 1913.

PUPA, ♂

Antennal sheaths enormously enlarged, viewed from beneath, the swollen bases nearly contiguous on the median line; just above and entad of the cephalic inner margin of the eye, provided with a sharp, chitinized spine placed in an eye-like depression. The antennæ bend laterad and dorsad to near the pronotal breathing horns and then ventrad, running caudad, closely appressed to the ventral side of the body, lying just inside the inner margin of the wing-sheath and outside the second pair of legs; the tip of the antenna is just beyond the middle of the fourth tarsal segment of the middle legs. In older pupæ the spines on the ventral side of the adult organ are clearly apparent through the cuticle. *Cephalic crest* (plate III, E)—From between the bases of the antennæ arises a flattened crest directed cephalad, deeply bifid by a square median notch, each of the lateral lobes thus formed being provided with chitinized points which are beset with sparse hairs; on each

side at the base of the crest, just cephalad of the swollen antennal base is a small subchitinized tubercle bearing a bristle. *Eyes* moderately large, occupying the space between the scape of the antennæ and the basal segments of the antennal flagellum. The anterior arms of the tentorium show through the cuticle, the arms rather short, elongate-triangular, directed toward the caudal end of the eye. *Labrum* large, roughly triangular, transversely wrinkled and bearing a conspicuous tubercle on either side near the base (which probably represents on the ectal surface the propharynx underneath, according to Dr. MacGillivray). The lobes of the *labium* project caudad on either side of the labrum, occupying the space just cephalad of the fore coxa and proximad of the tip of the fore femur. The *maxillæ* are represented by a quadrate plate on either side, lying just caudad of the eye, laterad of the clypeus and labium and cephalad of the knee-joint.

Thoracic notum quite convex, the *pronotal breathing horns* short, directed cephalad, dorsad and laterad, distinctly crenulated, not visible from beneath. The *mesonotal præscutum* delicately wrinkled medially, the V-shaped suture rather indistinct in young pupæ, clearer in darker, older pupæ. Median lobe of the mesonotal scutellum well indicated, projecting dorsad and caudad as a conspicuous point. *Wing-pad* attached opposite the basal quarter of the fore tibia, directed caudad, the tip of the pad lying opposite the ends of the second tarsal segments of the fore and middle legs and opposite the end of the second abdominal segment. *Halteres* originating on the side of the metanotum, hidden by the wing-pad, the tip at the extreme base of the second abdominal segment and just before the apex of the hind tibia. *Fore legs* (plate II, A), viewed from beneath the fore coxæ (g) are seen lying just caudad of the lobes of the labium; the coxa, trochanter and extreme base of the femur lie in one straight piece contiguous on the median line. Just beyond the base of the femur the segment bends cephalad upon itself and lies parallel with the coxæ and trochanters (h) the tip of the femur lying laterad of the labial lobes and just caudad of the maxillæ. At this point the tibiæ

(i) bend obliquely back across the body so that their tips are not distant from the middle line of the body; the legs touch the pair of the opposite side at the basal fourth of the metatarsus, the remaining tarsal segments running directly caudad and on either side of the middle line of the body. *Middle legs*—The coxæ and trochanters (j) occupy the sternal region of the pupa immediately behind the bend in the fore femur, the tip of the middle trochanter (j) corresponding closely to the tip of the fore tibiæ (i). The middle femur lies beneath (dorsad of) the fore tibia, the middle tibiæ being outside (laterad) of the fore tibiæ and lying parallel with them; the tip of the tibia is about opposite the basal third of the fore metatarsus; the tarsi run parallel with the hind tarsi and end on a level with them. *Hind legs*—Only the coxæ are visible, lying between the bases of the fore metatarsi; the remainder of the leg with the exception of the terminal tarsal segments is concealed by the sheaths of the fore and middle legs and the wings. The femur and tibia are very strongly bent, the tip of the tibia occupying a position that is exactly caudad of the tip of the femur, the tarsi running caudad. The tip of the metatarsus is seen just proximad of the radial region of the wing or just laterad of the antennæ. The hind tarsus projects conspicuously beyond the other tarsi, the tips of the two anterior pairs ending about opposite the middle of the fifth tarsal segment, which here bends strongly inward; tip of the tarsus ending before the caudal margin of the third abdominal segment.

First abdominal segment short, exceeded by the halteres; segments II to VII about equal in length, VIII very narrow, bearing the ninth segment on its caudal face. *Tergites*—First narrow, its caudal margin gently concave, not provided with spicules; segment II indistinctly divided into two approximately equal parts by a transverse false constriction, the caudal margin of the segment provided with about thirty-two chitinized spicules. Segments III to VII with the caudal half of a different texture from the basal half, being somewhat more chitinized, the basal half provided with feeble transverse wrinkles, the caudal margin of each segment provided with chitinized spicules which de-

crease in number toward the end of the body, there being about thirty-two on segment III and twenty-four on segments V and VI. Segment VII has the median line devoid of spicules, each side being provided with about seven arranged in a slightly curved line. Segment VIII very small, inconspicuous, the lateral angles of the caudal margin provided with a few weak hairs and the dorsal surface with several tubercles. Ninth segment bearing the hypopygium, the tergal plate small, ending in two chitinized cylindrical lobes, sharp-pointed, the points directed sharply dorsad. *Sternites*—Segments I and II pale, unarmed, hidden by the leg-sheaths; segments III to VII quite as in the tergites, the third segment with an interrupted row of spicules, about twelve in the middle and two larger ones on either side; in some specimens the row is complete and contains thirty to thirty-two spicules. Segments IV to V with complete rows of about twenty-four spicules; segment VI with a wavy, somewhat broken row of about twenty spicules; segment VII with about five feeble spicules on either side of the bare middle line; ninth sternite broader at base than at tip; tip truncate with the outer angles rounded with a very deep median split. *Pleurites,* non-chitinized, segments II to VII bearing spiracles, these spiracles located just caudad of the false transverse constriction and a little nearer to the sternites than the tergites.

Young pupæ, when alive, are very pale, the soft abdomen being almost white, the chitinized anterior portion very pale brown. Older pupæ are much darker, the chitinized parts becoming black with a bronzy reflexion, the abdomen much paler, of a dirty brownish-grey. The breathing horns are dark brown on the apical half. Young pupæ, in alcohol, are light yellowish brown, abdomen clear yellow, the pleurites a little darker.

Length, from crest to tip of abdomen—♂, 13.2-15.2 mm; ♀, 14-15.4 mm.

Dextro-sinistral width at wing-pad—♂, 2.1-2.2 mm.; ♀, 1.8-1.9 mm.

Dorso-ventral depth at wing-pad—♂, 2.1-2.3 mm.; ♀, 2.2 mm.

PUPA, ♀

In this sex the crest is smaller (plate III, B), reduced to two triangular lobes with the notch between these lobes very deep; the antennal sheaths are not swollen basally so that the pronotal breathing horns are visible from beneath; antennæ short, extending to a point just beyond the base of the wing. Arrangement of the legs about as in ♂; in one specimen the two terminal tarsal segments of the hind legs project beyond the tips of the other feet; the base of the fore femur is not before the first bend but this segment of the leg is just at this bend. The ninth sternite of the abdomen (plate III, F) is triangular, quite pointed at the tip, with a deep median split; ninth tergite with a broad notch, the lobes small, triangular, divergent, not strongly chitinized and directed strongly dorsad. There is only a little difference in the shape of the ends of the abdomen in the ♂ and ♀ pupa of this species.

Both sexes of the pupæ described from numerous specimens, Fall Creek, Ithaca, New York, May 1, 1913.

ERIOCERA SPINOSA Osten Sacken

1859 *Arrhenica spinosa* Osten Sacken; Proc. Acad. Nat. Sci. Phil., p. 244.

LARVA

Fully grown, fully extended, 40-45 mm.; diameter, 4-5 mm.

Color of larva varies from very pale whitish to rather dark brown; the skin has conspicuous bronzy reflexions in life.

The larval head differs from that of *E. longicornis* Walker, as described before, in the following essentials. (See plate I, A).

Genal plates not ending in a sharp protuberance on their inner cephalic angle, the inner margin being almost straight. The lateral lobes of the frontal sclerite are very pronounced, longer than the labrum itself. The hairs at the tip of the antennæ are shorter, not more than one-third to one-fourth the length of the segment. The mandibles (plate I, F) lack the prominent conical tooth at midlength. The head-capsule is much broader in proportion to its length, measuring 3.5 to 3.8 mm. by 1.8 to 2 mm. (across the genal plates).

Stigmal field (plate I, figure I) with the spiracles small, dorsal, rounded or rounded-oval, widely separated; four slender, elongate lobes around the stigmal field, one pair being lateral and the other ventral. Lateral lobes with the inner face having a narrow black line, this beginning as an enlarged black spot just ventrad of the spiracle, reaching the tip of the lobe; the dorsal outer edge of this lobe with a dense fringe of long conspicuous reddish hairs, the inner edge of the row beginning just laterad of the spiracle where the hairs are exceedingly short, gradually becoming longer to the tip where they are as long as the lobe itself. Ventral lobe with a narrow black line on the proximal face which divides at the base of the lobe, the ventral branch running along the ventral margin of the stigmal field, the dorsal branch paler, spreading out across the stigmal field and approaching its fellow of the opposite side on the middle line; a dense fringe of conspicuous reddish hairs on the tip of the lobe and continued on the outer dorsal side for a short distance toward the base. A few dusky brown spots on the stigmal field between the stigmata; two small hairs occupying the space between the stigmata. Underneath the caudal lobes and behind the swollen penultimate segment are the four caudal gills, short, stout, cylindrical, unbranched, the lateral pair directed outward, the inner pair directed caudad.

Described from abundant larvæ from along Fall Creek, Ithaca, New York, above the second bridge, in Forest Home, May 1, 1913.

PUPA, ♂

Antennal sheaths elongated (plate II, figure E, plate III, figure D), the tip of the sheath lying just before the end of the middle metatarsus, in a few specimens even reaching beyond the tip. *Cephalic crest* (plate II, E, b) very reduced, scarcely projecting beyond the front level of the antennæ; viewed from beneath (plate III, D), it is somewhat quadrate, the fore lateral angles produced into small pointed lobes bearing a long hair at the apex; viewed from the side (plate II, E, b) it is seen to be notched, there being a second lobe, subequal to the ventral one in size, immediately behind it, this also bearing a large hair.

Spine on the scape of the antennæ (plate II, E, c; plate III, D) enormous, somewhat curved, directed ventrad. The inner caudal surface of the eye also bears a conspicuous tubercle. The tentorium between the caudal ends of the antennal scapes is produced into a small median tubercle (plate II, E, d). The tubercles on the base of the labrum or end of the clypeus (plate II, E, e) are very large, close together, the tips strongly chitinized.

Pronotal breathing horns long, slender (plate II, E, a), broad at the base, tapering to a rather sharp point, the organ arcuated so that the point is bent strongly ventrad. Mesonotal scutellar lobe prominent, rather strongly projecting. Leg-sheaths with the terminal tarsal segments about on a common level and opposite the end of the third abdominal segment. Wing-pad light brown, the venation showing very clearly, the presence of cell M_1 in connection with the elongate antennæ being characteristic of this species alone in Eastern America.

Second abdominal tergite with a conspicuous basal tubercle on either side of the median line. Spicules very strong, almost spinous, about twenty to twenty-two on tergites II to V. Tergites VI and VII destitute of spicules but with four subapical setiferous tubercles. Tergites II to VII with a conspicuous setiferous tubercle on the ventro-cephalic angle of each caudal annulet. Eighth tergite concave on caudal margin (plate II, D) bearing a pair of strong apical tubercles on either side of the median line. *Sternites*—Segment III with two spicules on each outer angle; segments IV to VI with about sixteen spicules (sometimes as many as twenty); segment VII with about ten. Segments IV to VII with a small setiferous tubercle about midlength of the caudal annulet, widely separated. Segment VIII (plate II, C) without soft pleural region, bearing an apical row of strong spines which is broken only on the dorsum and for a small space on the median line of the venter, there being about twenty of these spines on the segment. Ninth sternite (plate II, C, a) rounded, swollen, with a deep median furrow bearing a small lobe on the ventral side at the end of this split. Ninth tergite (plate II, D, a) produced caudad into two strong

conical points with a V-shaped notch between them, these points directed caudad and slightly dorsad, each one a little split near the tip on the outer face and with a prominent lateral tooth at about mid-length.

Pleural region of abdomen rather restricted, longitudinally wrinkled. Spiracles large, elliptical, transverse, placed about mid-length of the segment. About three small setiferous tubercles on each pleuron ventrad and caudad of the spiracle; another setiferous tubercle on the dorso-cephalic angle of each pleuron.

In life, pupæ vary from a very pale yellowish to dark, almost black, the deepest coloration being the head and thorax; the body often with bronzy reflexions.

Length, from crest to tip of abdomen—♂, 26.5-27 mm.; ♀, 25-28.5 mm.

Dextro-sinistral width at wing-pad—♂, 3.4-3.9 mm.; ♀, 3.4-4 mm.

Dorso-ventral depth at wing-pad—♂, 4-4.2 mm.; ♀, 3.5-4 mm.

PUPA, ♀

Quite like the ♂, the sheath of the antennæ short, reaching a point just beyond the end of the fore coxæ or some distance beyond the base of the wing. Ninth sternite (plate III, H) elongated, cylindrical, its tip rounded, feebly split underneath. Ninth tergite (plate III, I) very long, pointed, with a deep median split.

Numerous ♂ ♀ pupæ, Fall Creek, Ithaca, New York, May 27, 1913, taken from the gravelly beds along the creek above the second bridge in Forest Home.

ERIOCERA FULTONENSIS Alexander

1912 *Eriocera fultonensis* Alexander; Psyche, vol. 19, p. 168, 169.

LARVA

Fully grown, fully extended, 18-26 mm.; diameter, 2 mm.

Form long and slender. Color pale flesh color, the cephalic segments a little darker, brownish, the enlarged subterminal swelling almost transparent.

The larval head differs from that of *E. longicornis* Walker or *E. spinosa* O. S., as described before, in the following essentials:

Genal plates (plate I, D) at their inner cephalic angle evenly rounded, not produced into a prominent lobe. The *labrum* (plate I, B) is much more produced, conical, bearing a little tuft of hairs at the tip and a small, cylindrical, chitinized tubercle on either side of the tip; the lateral lobes are very prominent, cylindrical, densely clothed with long short hairs, the lobes bent prominently inward. *Antennæ* (plate I, C, a) more club-shaped, the distal end being larger than the base; hairs at the apex short. Mandibles (plate I, G) with a prominent conical tooth at mid-length, this tooth squarely truncated at apex and bearing a smaller tooth at its side. Size of the head-capsule, 2.7 by 1.2 mm., across the genal plates.

Stigmal field (plate I, J) with the spiracles rounded-oval to rounded, placed obliquely, very widely separated from one another. Four conspicuous lobes surrounding the stigmal field, of which one pair are lateral and the other ventral. Each lateral lobe slender, with a narrow straight black mark on its inner face, at its inner end, this mark scarcely if at all enlarged; the lobe bears a dense fringe of long, delicate, pale brown hairs along its dorsal face, these hairs quite inconspicuous due to their pale color. Each ventral lobe very long and slender, the inner face with a narrow, straight black line which is expanded out at the base into a dark brown triangular mark which meets its fellow of the opposite side on the median line, the two enclosing a pale, oval area between them; a fringe of rather long pale hairs on the apical third of this lobe. A pale brown mark runs from each stigma dorsad. Stigmal field almost destitute of dark spots or marks.

Described from several larvæ taken in sandy banks of Fall Creek, Ithaca, New York, May 30, 1913.

PUPA, ♂

The male pupa is quite like the ♀ described below; the bristles on the lobes of the crest are very long, exceeding the

lobe itself, there being three of these elongated bristles on the dorsal lobe and one on the ventral lobe, it being directed caudad. In the ♂ the abdomen ends in a blunt, rounded lobe deeply divided into two parts, strongly suggestive of the powerful hypopygium of the adult male of this species. Total length of the ♂ pupa, 10-12 mm.

PUPA, ♀

Differs from the pupa of the same sex of *E. longicornis* (q. v.) in the following essentials:

The general form is much stouter and the body is covered with numerous appressed hairs. The sharp spine on the scape of the antennæ is lacking; the lobes of the cephalic crest are small (see plate II, F, b; plate III, C) and tend to converge when viewed from beneath, and are covered with small, rounded warts or tubercles; in front, above the base of the antennæ, are two more large lobes so that the crest is four-lobed instead of bi-lobed as in *longicornis;* these anterior lobes are smaller, rounded, and usually end in an apical tip or spur directed ventrad. The pronotal breathing horns (plate II, F, a) are very long and rather slender; the mesonotum more convex than in *longicornis;* the wing-pad usually shows the venation clearly on the pale background and the presence of crossvein *r* connecting R_1 with R_{2+3} is distinctive of this species; the absence of cell M_1 separates this pupa from *E. brachycera* O. S., *spinosa* O. S., et al. The leg-sheaths end almost on a level, the outer or hind pair being but a trifle longer than the two inner pair. The spicules on the caudal margin of the abdominal segments are smaller and more numerous, on some of the segments (fifth and sixth tergites) averaging forty. The ninth abdominal segment (plate III, G) is much longer than in *longicornis,* the ninth tergite elongate, pointed, much longer than the ninth sternite and scarcely directed dorsad, being much more like a typical ovipositor than in *longicornis.*

Fully colored pupæ are dark brown, the cephalic crest being paler, the pronotal breathing horn is pale yellow, darkening into brown at the tip. The wing-pads are light yellow with the

venation showing clearly, dark brown. The pleurites of the abdomen are darker brown than the sternites or tergites; ninth segment dull yellow.

Length, from crest to tip of abdomen—♀, 14-16 mm.

Dextro-sinistral width at wing-pad—♀, 1.8-2 mm.

Dorso-ventral depth at wing-pad—♀, 2.5-2.7 mm.

These specimens were taken at Ithaca, New York, as larvæ on May 30, 1913; they were removed from the breeding jars as fully-colored pupæ on June 6, 1913. The single ♂ I possess is represented only by a cast skin, taken as a larva on May 30, and emerging as an adult fly on June 6.

EXPLANATION OF PLATES

PLATE I.

A. Head-capsule of larva of *Eriocera spinosa* O. S., dorsal aspect, a little elongated to show the shape of the head of *fultonensis* and *longicornis*. a, mandible; b, antenna; c, maxilla; d, labrum; e, genal plate.

B. Clypeo-labral sclerite of *E. fultonensis* Alex., dorsal aspect.

C. Antennæ of larvæ. a, *E. fultonensis;* b, *E. longicornis.*

D. Genal plate of *E. fultonensis,* dorsal aspect.

E. Same of *E. longicornis.*

F. Mandible of larva of *E. spinosa.*

G. Same of *E. fultonensis.*

H. Same of *E. longicornis.*

I. Dorso-caudal aspect of end of the abdomen of *E. spinosa* larva.

J. Same of *E. fultonensis.*

K. Same of *E. longicornis.*

L. The stigmal field of the last-named, more enlarged.

PLATE II.

A. Ventral aspect of ♂ pupa of *E. longicornis.* a, cephalic crest; b, scape of antenna; c, anterior arms of the tentorium; d, maxilla; e, labrum; f, labium; g, fore coxa; h, fore femur; i, fore tibia; j, middle coxæ; k, wing-pad; l, elongate antennal sheath; m, second abdominal segment, bearing spiracle.

B. Dorsal aspect of ♂ pupa of *E. longicornis.* a, cephalic crest; b, enlarged base of antennæ; c, pronotal breathing horns; d, mesonotal præscutum; e, mesonotal scutum; f, mesonotal postnotum.

C. Ventral aspect of end of abdomen of ♂ pupa of *E. spinosa.* a, ninth sternite; b, ninth tergite.

D. Dorsal aspect of same. a, ninth tergite; b, ninth sternite.

E. Lateral aspect of ♀ pupa of *E. spinosa.* a, pronotal breathing horn; b, cephalic crest; c, spine on antennal scape; d, tubercle on tentorium; e, tubercle on clypeus.

F. Same of *E. fultonensis.*

G. Same of *E. longicornis.*

PLATE III.

A. Lateral aspect of ♂ pupa of *E. longicornis.*

B. Ventral aspect of ♀ pupa of *E. longicornis.*

C. Same of *E. fultonensis.*

D. Same of *E. spinosa.*

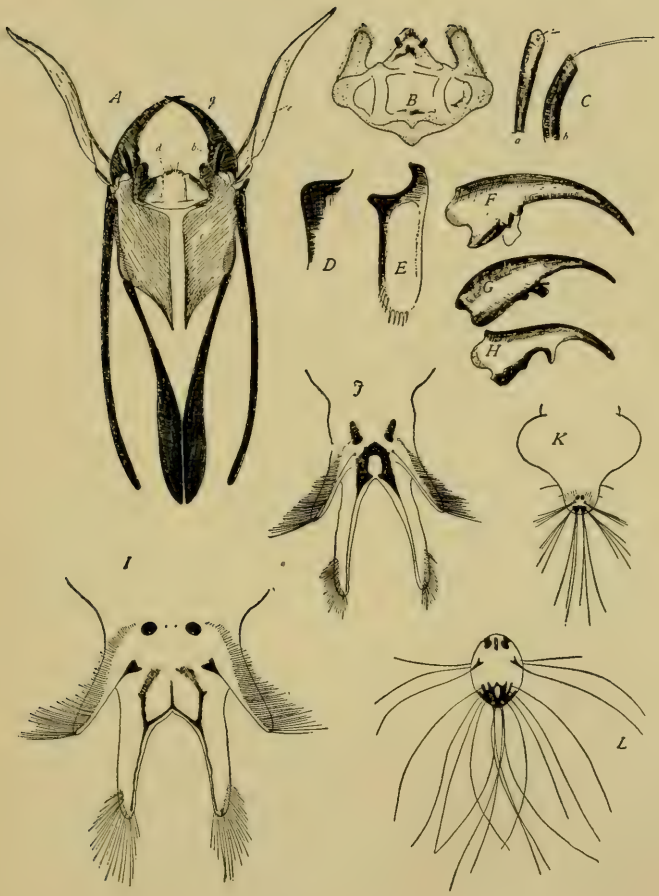
E. Ventral aspect of head of ♂ pupa of *E. longicornis.*

F. Lateral aspect of abdomen of ♀ pupa of *E. longicornis.*

G. Same of *E. fultonensis.*

H. Ventral aspect of abdomen of ♀ pupa of *E. spinosa.*

I. Dorsal aspect of the same.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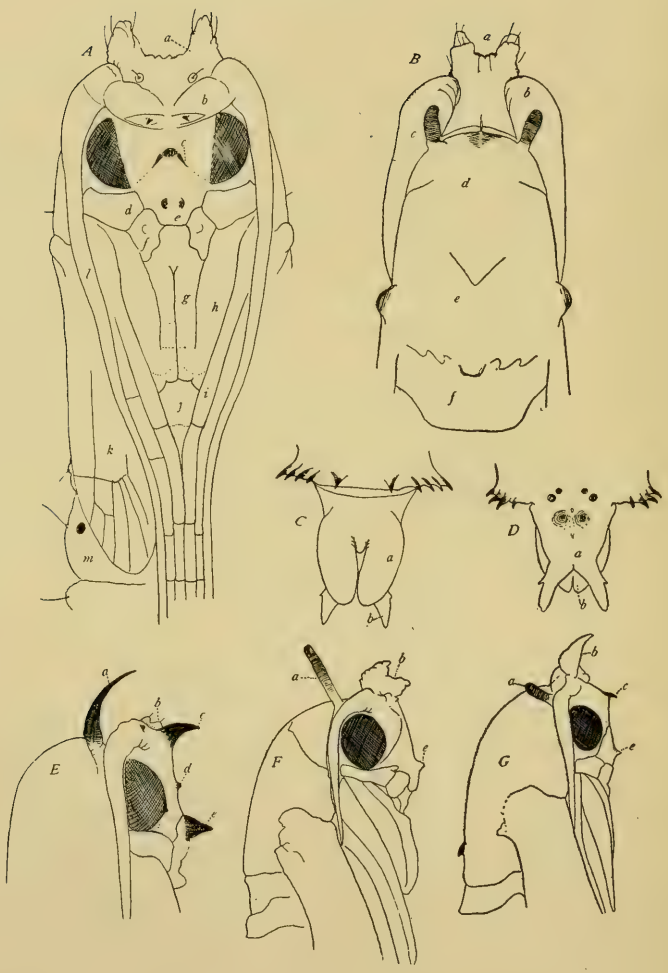
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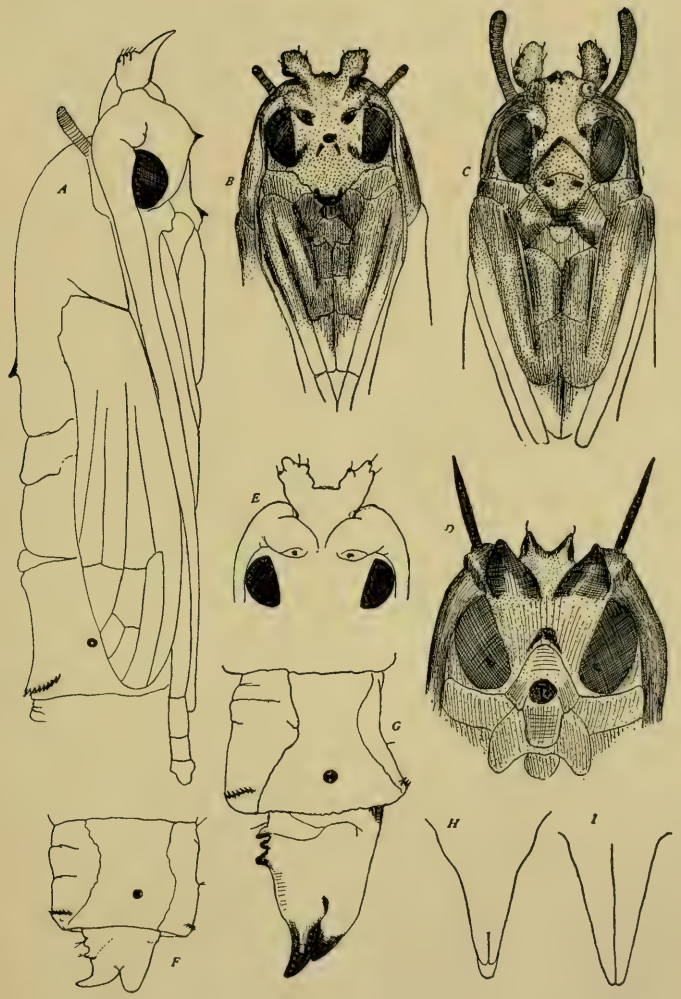
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The Central Ganglia of *Xenylla*

WILLIAM A. HILTON

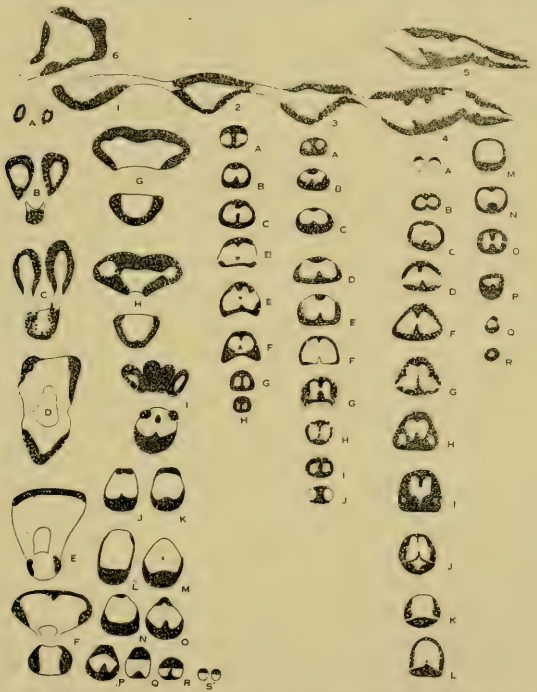
Serial sections were made through the entire animals of the genus *Xenylla* of the family Poduridæ. The length of the animals after they were fixed and imbedded in paraffine was about one millimeter. By means of longitudinal and cross sections the ganglia were studied.

At this time the peripheral nerves and sense organs will not be considered to any degree. This form has eyes, the nerves supplying them are very short. The anterior and lateral portions of the brain are connected with these organs. The nerves to the antennæ are from the lateral portions of the supraesophageal ganglion. They are accompanied with nerve cells for a short distance, as is shown in one of the figures. Although no postantennal organ was found, there were some evidences of a ganglion which seemed to correspond in position to this structure which has been found associated with the postantennal organ of Collembola.

The general form of the central nervous system of Collembola was perhaps first described by Nicolet in 1841. Three ventral ganglia were recognized, two thoracic and one abdominal. Sommer in '85 found four nerve centers below the head, three of these are called thoracic and one abdominal. Lubbock '73 found three ganglia in the thorax and abdomen of *Tomocerus*. Linear species of Collembola are described as usually having two thoracic and one abdominal ganglion. Fernald '87 in *Anurida*, recognizes pro-, meso- and metathoracic ganglia. The last of these seems composed of two ganglia.

There are a number of other papers which describe or figure the complete nervous system of some species of Collembola. Among the more recent of these are those of Philiptschenko '12, Hilton '13. As a rule two chief cephalic ganglia are described and three others in linear species.

In *Xenylla* the ganglia are much like those in *Aphorura* previously described. The supraesophageal ganglion is continued towards the antennæ on either side and these lobes are well covered with nerve cells on the surface. The lateral por-



The figure at the top is a longitudinal section through the central nervous system of *Xenylla*. 1 and 6 are the head ganglia; 2, 3 and 4 are the body ganglia; 5 is a section of the last ganglion at another level. The dorsal side is up. Under 1, from A to S, are drawings of cross sections from another series through the head ganglia at intervals in the nervous system of 5 microns. The dorsal side is up. Under 2, there are similar sections shown from the first thoracic ganglion of the same series. The sections run from A to H, every 5 microns. Under 3 and 4 continuations of the same series are given through the two lower ganglia in the same way. The dorsal side is up and all figures are drawn to the same scale, which is X 200.

tions of this ganglion are closely applied to the region of the eyes and the ocular lobes are evident as lateral extensions of the brain some distance from the connection with the subesophageal center. The nerve cells form a sheath over the central mass of fibers in most parts of the brain, only a few ventral and lateral areas are without them, with the exception of a small dorsal region not far from the level of the eyes. The length of the brain in a specimen of about 1 mm. in length was found to be about 45 microns. In this part of the central nervous system as in all other portions the nerve cells are very small.

The subesophageal ganglion although longer than the brain is much less broad and deep. A considerable portion of its dorsal surface is without nerve cells, as well as some lateral portions. The center extends from near the forward region of the brain to some distance back of it. In the same specimen mentioned above, the length of the subesophageal in section was found to be about 90 microns.

The first thoracic ganglion is the shortest of all the chief ganglia, being about 40 microns. Nearly all parts of the central fibrous center are covered with nerve cells. The bi-lobed nature of the ganglion is evident in this nerve center.

The second thoracic ganglion is quite similar to the first. It is about 50 microns long in this specimen.

The last ganglion is evidently composed of a number of elements. In all specimens, both young and old, there is a clear indication of a cephalic portion which seems but recently fused with the more caudal mass. This is shown in the figures of cross sections, but more especially in median longitudinal views. Fig. 4 shows something of this, as does the drawing of a more lateral median section shown in 5. These views of this ganglion show also with great clearness a number of divisions of fibers and cells which may indicate the fusion of a large number of abdominal segments.

From a study of the sections and the figures presented the following points may be mentioned:

1. The chief ganglia are much as in other linear Collembola.

2. Cells of small size surround the central fibrous masses of the ganglia. The ganglia below the head show fewer areas of fibers uncovered with cells than the head ganglia.

3. The cells of the ganglia extend down upon the connectives.

4. The connectives are bilateral and the lower ganglia show a bilateral form with the two sides more or less distinctly marked.

5. There is some indication of the fusion of several parts in many of the ganglia, but the last ganglion shows very clearly, a thoracic part and an abdominal portion. The abdominal portion seems to be composed of a number of fused segments.

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(Contribution from the Zoological Laboratory of Pomona College.)

A New Species of Pseudoscorpion from Laguna Beach, California

MARGARET LYONS MOLES

Chelanops lagunæ n. sp.

Measurements—Length of animal including mandibles, 2.5 mm; length of palps, 2.5 mm.; length of claw, 1.05 mm. The whole animal is three times as long as it is broad.

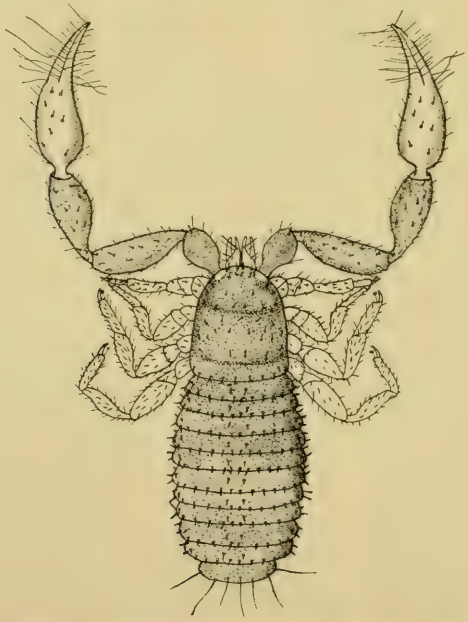

Figure 1. *Chelanops lagunae* n. sp., from above, X25.

Color—Cephalothorax reddish brown, palps reddish brown, legs pale yellowish brown and abdomen light brown.

Cephalothorax not quite as broad as long. Front margin evenly rounded, sides slightly convex and lower margin truncated. Two distinct sutures, two indistinct eye spots.

Abdomen one and one-half times as long as it is broad and divided into eleven distinct scutæ. Scutæ well rounded and all of the same size except the last one, which is longer and broader and has long simple hairs on its base.

Figure 2. *Chelanops lagunae* n. sp., palps showing conical teeth, X 50.

The whole body is finely granulated and furnished with short clavate hairs.

Palps, length 2.5 mm., as long as body. Coxa smooth, trochanter as usual. Femur shorter than cephalothorax, pedicellate, broadest near the base, concave on inner margin near tip. Tibia a little shorter and slightly broader than the femur, pedicellate, evenly convex on outer side, slightly convex on

inner side near base and beyond slightly concave. The trochanter, femur and tibia finely granulated and sparsely furnished with short clavate hairs. Claw, moderate size, as long as cephalothorax plus mandibles. Fingers slender, quite strongly curved, nearly as long as the hand, the inner margins provided with a row of conical teeth. Hand strongly convex on inner side, tapering to the fingers, not so strongly convex on the outer side. Hand finely granulated and with few clavate hairs, fingers smooth with many long simple tactile hairs.

Mandibles robust for the size of animal; the fixed finger provided with many small teeth. Serrula attached throughout length of moveable finger. Flagellum separated into four thin parts. Spinnerets short and transparent. Mandibles covered with long simple hairs.

Legs, each with a trochantin, claws simple, legs covered with strong clavate hairs.

Habitat—Sycamore Canyon, near Laguna Beach. Collected from sycamore trees about a quarter of a mile from the ocean.

The species differs from *Chelanops dorsalis* Banks by having two indistinct eye spots.

(Contribution from the Zoological Laboratory of Pomona College.)

Neanura Gigantea Tull in Southern California

GERTRUDE BACON

This species of Collembola has been reported from St. Paul Island in the Bering Sea, Siberia, and in the vicinity of St. Laurence Bay. It is therefore interesting that a number of specimens of this species were collected from five places near Claremont, California. About twenty specimens were first obtained in a rotten piece of wood in Cucamonga canyon during the month of November, 1913. Since then one specimen was obtained from Fern canyon, a number from Palmer's canyon, and several were found among the rocks in the hills south of Pomona and also in the hills south of Chino. They have been searched for in other places, including the hills near Laguna but without success. The specimens obtained seemed to be the same as those described by Prof. J. W. Folsom in one of his papers from the Harriman Alaska Expedition, except that they have one more tubercle on the anterior part of the head. Those described by Folsom have only one tubercle between the eyes, while my specimens have two. (Fig. 1.)

Length 3-5 mm. Width 1.5-2.5 mm. Color—Dark blue, lighter on the ventral side. Body—Broad, flat, covered with large dark tubercles, the numbers on each successive segment being 6, 8, 8, 8, 8, 8, 8, 6, 2. Each tubercle bears several long hairs. Head—A little longer than the first two segments, triangular in shape, divided into two parts, a raised upper portion with five small tubercles and two large tubercles containing the eyes, and a lower portion with six large tubercles. Antennæ (Fig. 2 A)—Short, not as long as head, on the dorsal side it is hard to distinguish more than three segments, but four show plainly on the ventral side; basal segment is round, the terminal one is as long as the other three together; no sense bulbs. Ocelli (Fig. 2 B)—Five in each eye spot, situated on a tubercle with three large hairs. Post-antennal organ (Fig. 2 C)—Present, circular, composed of over

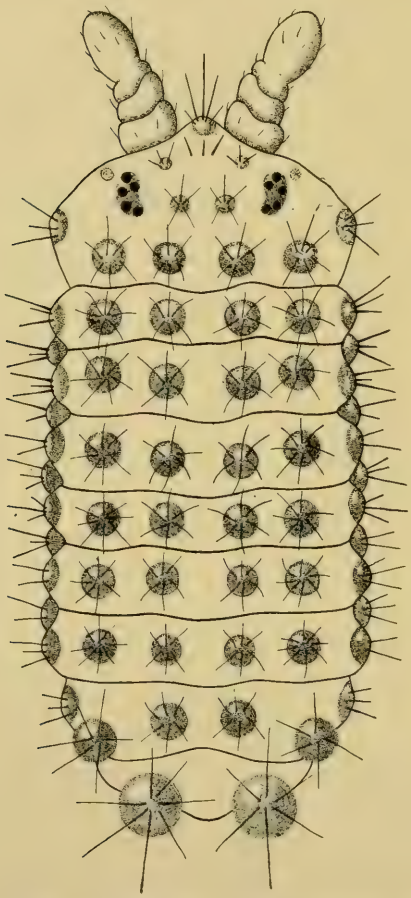

Figure 1. Dorsal view of *Neanura gigantea* Tull.

a hundred tubercles. Legs (Fig. 2 D)—Short and stout, each bearing a claw which is curved with a small tooth not quite midway; minutely tuberculate. No anal horns.

(Contribution from the Zoological Laboratory of Pomona College.)

Figure 2. Parts of *Neanura gigantea* Tull. A, antenna; B, eye spot; C, post-antennal organ; D, leg; E, claw.

Shorter Articles

A HISTORICAL KERMES (*COCCIDÆ*)

The Ninth from California

GEO. B. KING
Lawrence, Mass.

Kermes sassceri n. sp.

Female scale—Before forming the hard shell the female is white, marbled with gray, turning nearly white when the hard shell is formed. After the scale has been collected and placed in a vial or box the color turns to a very light tint of lemon yellow. The form is not perfectly globular, but rather somewhat transverse and with a more or less pronounced and rather broad medio-dorsal depression which gives it a bilobed appearance. In many specimens this depression forms a rather broad, black or dark brown band following frequently its entire length and generally crossed by narrow blackish or brownish transverse lines of various lengths. Between these lines are several black specks as large as a pin head. The entire surface of the scale is covered with minute black specks. The place of attachment to the host plant is dark brown.

Kermes sassceri n. sp. (Photo by E. O. Essig).

Female larvæ—The young female larvæ are grayish-brown, elongate-oval, 480 microns long, 260 microns broad. Antennæ—Six jointed; joint I, 20 microns; II, 16 microns; III, 24 microns; IV, 12 microns; V, 16 microns; VI, 24 microns; formula, III, VI, I, (II, V), IV. Front legs—Length and breadth, coxa, 20 x 36 microns; femur and trochanter, 80 x 24 microns; tibia, 36 x 20 microns; tarsus, 52 x 16 microns; claw, 16 microns.

Habitat—Lawrence, Mass., on *Quercus rubra*. It is allied to such species as *Kermes arizonensis* and *K. nigropunctatus* by being covered with minute black specks.

In July, 1900, I published a synopsis of the North American species of *Kermes* (see Psyche pp. 78-84) and cited the above described species as *Kermes galliformis* Riley, which was an error. I based my opinion on the figure published by Prof. Comstock in the U. S. Agrcl. Report for the year 1881, plate IX, fig. 1, which represents the species herein described. I did not read understandingly what he said of it. He distinctly says it is a figure of a *Kermes* found in California. In August, 1900, I sent some examples of this species to Dr. Howard. The material was turned over to Mr. Pergande, who, on August 23d, wrote me that the species which I had referred to *Kermes galliformis* was not that species, but a new one, which had been received by them from Pennsylvania, New York, Massachusetts, Rhode Island, and Toronto, Canada. In 1906, Mr. Edward K. Carnes published a list of *Coccidæ* of California and on page 18 reproduces Comstock's figure of the California species and cites it to represent *Kermes nigropunctatus,* which is another error. The above described species has been known for at least thirty-three years without a name and I am pleased to name it after Mr. E. R. Sasscer of the U. S. Dept. of Agriculture, now assistant curator of the collection of *Coccidæ* at Washington, D. C.

THE ARGENTINE ANT

The Argentine ant, *Iridomyrex humilis,* is now found not far from Claremont, Cal., as well as in other places in Los Angeles county. Although it does not seem to be much of a pest in its own country it certainly appears to be here. It has attracted attention chiefly because it invades houses in wet weather and requires much trouble to keep it out. It devours all sorts of food substances, especially sweet things. In some places it has become a very serious menace to shade trees and ornamental plants as it protects plant lice. It also seriously attacks flowers in orange groves. In market gardens it removes the seeds before they sprout. In Louisiana the mealy bug thrives under its protection. Fig crops are greatly injured by the pest. Bee-keeping becomes almost impossible where the ants

are abundant. In poultry yards they disturb the sitting hens and may even kill little chicks.

No affected areas are far from the railroads, but the ants spread, driving the local species out as they extend their territory.

Zenoleum powder has been used against them with success. Crude petroleum was found to be the best repellent of all liquids.

A FRUIT FLY FROM FUNGI

In connection with a study of fungus gnats a large number of small flies of an entirely different character were reared. These insects came from larvæ which were found in great abundance in the thick mud-like mass which resulted from the almost complete decomposition of the mushrooms. Time and again fungi which were brought into the laboratory yielded these small fruit flies. A number of specimens were sent to Prof. Aldrich for identification. They proved to be *Drosophila busckii* Coq.

This species is reported as widely distributed over the state but we have not heard of its being reared from fungi before.

E. T. McFadden.

THE ENTOMOLOGICAL CLUB

The Entomological Club met at the residence of Dr. Adalbert Fenyes, in Pasadena, on the evening of January 31, 1914, with the following men present: A. J. Cook, E. O. Essig, H. S. Smith, J. H. McLaren, A. G. Smith, H. C. Fall, A. Fenyes, H. H. Newcomb, W. A. Hilton, V. L. Clemence, B. Berwald, G. C. Davis, B. Turner and F. Grinnell, Jr. Dr. A. G. Smith opened the meeting and introduced Dr. A. J. Cook, State Commissioner of Horticulture, who spoke in a very pleasing and interesting way of the work of the Commission in dealing with the injurious insects of California, with special reference to the control of the mealy bug and alfalfa weevil; and the necessity of fighting the pests right at the start. The difficulty of obtaining

sufficient funds at these times was mentioned, and usefulness of an emergency fund was spoken of. The migrations of the lady-bird beetles elicited considerable discussion by a number of men present which was continued by Mr. H. S. Smith of the State Insectary, who also spoke of the work of the Commission, especially the control of the alfalfa weevil, which is a serious pest. Mr. E. O. Essig gave a very interesting account of the structure, life history and habits of the mealy bugs, *Pseudococcus,* and the present difficulties in their classification, in properly separating the closely allied species which are exceedingly variable. He suggested some profitable breeding experiments, and concluded by speaking of control of these serious pests.

Mr. V. L. Clemence exhibited a box of butterflies, including *Lycæna neurona, Lycæna herri* and an aberration, *Lycæna hanno,* and the allied and recently described *florencia* from Arizona.

Dr. A. Fenyes showed some boxes of *Aleocharinæ,* microscopic slides of the same, and told of some of his work with these beetles, of which he has just completed a manuscript for the Genera Insectorum. The fine library of Dr. Fenyes was also seen.

The persons present then proceeded to the dining room where refreshments were served and enthusiastic discussion on various subjects was enjoyed.

Meeting adjourned at 11:45.

FORDYCE GRINNELL, Jr.,
Acting Secretary.

Wants and Exchanges

Subscribers and others are urged to use these columns to make their wants known. As the Journal goes to all parts of the world we hope to make this a very useful feature of the publication. Exchange notes are free to subscribers.

WANTED—Myriopods from all parts of the world. Will name, exchange or purchase. R. V. Chamberlin, Mu. Comp. Zoology, Harvard Univ., Cambridge, Mass.

Will exchange insects of any order from Southern California, for Microlepidoptera from any part of North America, preferably pinned, with complete data concerning capture. Fordyce Grinnell, Jr., Pasadena, Cal.

COCCIDÆ—California Coccidæ exchanged for specimens from all parts of the world. E. O. Essig, Secretary State Commission of Horticulture, Sacramento, Cal.

WANTED—Cephalopods (in alcohol); Chitons (in alcohol or dry); shells of West American Mollusca; zoological literature. Offered: West American and other molluscan shells; zoological pamphlets, mainly on the Mollusca. S. S. Berry, 502 Cajon St., Redlands, California.

California Syrphidæ, Aphididæ to exchange for non-California Syrphidæ. W. M. Davidson, Walnut Creek, Cal.

WANTED—For exchange, papers on marine and fresh-water Protozoa. Albert L. Barrows, Department of Zoology, University of California, Berkeley, Cal.

WANTED—Information on any mite-papers for sale or exchange that have an economic bearing. H. V. M. Hall, Room 8, Court House, San Diego, Cal.

WANTED—Specimens and separates relating to the pseudoscorpions, in exchange for local species. M. Moles, Claremont, Cal.

WANTED—Literature and determined specimens of Collembola, in exchange for local forms and literature. G. Bacon, Claremont, Cal.

WANTED—Determined specimens of Thysanura in exchange for local species. R. Gardner, Claremont, Cal.

WANTED—Separates relating to the nervous system and sense organs of the invertebrates in exchange for reprints by a number of authors on this and other topics relating to the anatomy of invertebrate animals. W. A. Hilton, Claremont, Cal.

New Acarina

NATHAN BANKS

Below are descriptions of several new mites, some of them from California and of economic value.

BDELLIDÆ

Bdella utilis n. sp.

Red. Body about twice as long as wide, broadest in the middle, and tapering toward each end; ocelli close together. The cephalothorax with six long bristles, two widely separated at about middle, and four behind in a transverse row, the two each side being close together; abdomen with a submedian row of four long bristles, one on humerus, and one each side toward tip, and about eight at tip, hardly as long as the others. Legs stout, fourth pair nearly as long as the body, all with many simple hairs; apical part of femora I and II hardly longer than broad, and tibiæ I and II about twice as long as patellæ. Beak long and slender, two and one-half times as long as broad near base, with a pair of bristles at about middle; palpus but little longer than beak, third joint fully twice as long as broad, and rather longer and broader than the fourth; fifth hardly as long as third plus fourth, with two bristles above, and two very long ones at tip. Length .8 mm.

From black scale imported into California from South Africa (Carnes).

Cunaxa armata n. sp.

Red. Body rather broad, especially in front; head about one and one-fourth as long as broad, rounded behind; mandibles very slender, reaching to the tip of third joint of the palpus. Palpi very long and stout, second and third joints (which are apparently united as in the European *C. taurus*) each about three times as long as broad, third with long curved spine below, fourth about as long as third, with a long spine on the inner

side, and a longer spine at tip; fifth claw-like, with a spine on inner side before the middle (in *C. taurus* beyond the middle). Cephalothorax with four long hairs; legs, slender, especially the tarsi, with a few short, fine hairs, one on the middle of penultimate joint of hind legs is longer than the others. Length .5 mm.

From Washington, D. C., May, on leaves. *C. quadripilis*, which is similar, has shorter mandibles, second and third palpal joints shorter, and the fifth joint has no spine, but a fine bristle from near base.

CHEYLETIDÆ

Cheyletus cocciphilus n. sp.

Body but little longer than broad, divided by furrow in middle, surface granulate above; cephalothorax with a submedian row of four scale-like hairs, and a submarginal row of three similar hairs; on abdomen are similar rows, but the scales are less broad, and near tip of the body, hardly more than thickened hairs, a lateral scale at broadest part of body on the posterior part of the cephalothorax. Legs not as long as width of the body; leg I with three scales, and other legs with thickened, often curved, hairs; leg I ends in two very long simple hairs. The head has a scale in front each side of the beak, and each palpus has two scales above. Each palpus ends in three combs, and two curved bristles. Length .3 mm.

From orange twigs infested with purple scale from Mayaguez, Porto Rico, April 30, (Carnes).

RHYNCHOLOPHIDÆ

Rhyncholophus mœstus n. sp.

Red. Body hardly twice as long as broad, broadly rounded behind, much narrowed in front, covered with many fine short hairs; on the frontal lobe are some long stiff bristles. The dorsal groove reaches almost to the abdomen, with a pair of pits or sensillæ at each end of it; one eye-spot each side on cephalothorax. Legs slender, first and fourth pairs hardly longer than

the body, all with fine hairs; the three long joints are subequal in length, the last joint of leg I is about two-thirds as long as the penultimate, the last joint of leg IV about one-half as long as the penultimate joint. Length 1.2 mm.

From Monrovia, California, June, (Essig).

TETRANYCHIDÆ

Caligonus terminalis n. sp.

Red. Body hardly twice as long as broad, much narrowed behind, the tip being almost acute, and with four stout, straight bristles. Suture between the cephalothorax and abdomen distinct; apparently but one eye-spot each side on cephalothorax, four bristles on cephalothorax; on dorsum of abdomen a submedian row of four rather long bristles and two each side nearer margin, and a longer and stouter humeral bristle. Palpi stout; thumb ends in two hairs, of which one is much longer than the other; claw long and evenly curved. Hind coxæ situated considerably behind the front pairs. Legs stout, no longer than width of body, with some long and a few short bristles; tarsi I and II with two long apical bristles. Length .3 mm.

From Chula Vista, California, May 7, on lemon leaves, (Quayle).

Tetranychus simplex n. sp.

Body one and one-half times as long as broad, slightly tapering, but rounded behind; with twenty-four long, stout bristles above, situated about as in *T. bimaculatus*, and two pairs of shorter bristles at tip. Legs of moderate length, first pair not as long as body, all with long, stout bristles; femora and tibiæ I and II with one above as long as those on the body; tibiæ I and II barely longer than these patellæ; tarsus ends in a simple claw, which has four bristles arising from near its base. Mandibular plate about twice as long as broad, tapering and rounded in front, without emargination. Length .3 mm.

From date palm, El Centro, Imperial County, California, July 29, (Carnes).

PARASITIDÆ

Ophiomegistus n. gen.

Belonging to the Antennophori section of the Parasitidæ. Body broad, rounded. Legs short, first pair without claws or caroncle, ending in several fine hairs. Peritreme long, and reaching forward in front of coxæ I. Ventral shield in two parts separated just in front of vulva; anal not separated, the ventri-anal shield occupying all the venter. Genital aperture of male only a short distance back of front margin of sternal plate.

Type—The following species:

Ophiomegistus luzonensis n. sp.

Body as broad as long, narrowed each side in front, above smooth, margin (except in front and concave anterior sides) provided with a row of stiff bristles, less than half a bristle length apart; a few, mostly near the tip, are longer than the others. Legs short and stout, first pair plainly longer and more slender than others, tipped with bristles, no claws; other legs with large caroncles, all with rather stiff scattered hairs. Venter in female with a transverse bowed line between coxæ III and IV, and a curved furrow in the middle behind it. Greater part of ventral surface provided with very short spines, pointing forward; behind are several curved rows of elongate scales, and near margin is a submarginal groove. The peritreme shows, on outer edge, near the spiracle, a series of transverse apertures, and forward are many of these slits in the thickened rim of the peritreme. The male genital aperture is transversely elliptic, and hardly half its short diameter from anterior margin of sternum; on hind femur is a curved tooth, and on submarginal groove, three teeth, the posterior two close together. Length .8 mm.

From Los Banos, Philippine Islands, on snakes, (Baker).

Polyaspis lamellipes n. sp.

Body not twice as broad as long, broadly rounded behind, rather narrowed in front. Leg I not as long as body; leg IV

barely longer than width of the body. Dorsum of body with two reticulate submedian stripes connected in front and behind, a sublateral corneous stripe on each side of body with six scale-like hairs, one nearly over coxa II, three each side close together, and two each side toward the tip; the sublateral corneous stripe also bears a few thickened bristles. Legs I and II with lateral lamellæ and clavate hairs as figured; legs III and IV with lamellæ narrower and with few clavate hairs; sternal shield with three thickened hairs each side; mentum or lip with two submedian long spines. Length .7 mm.

From Cedar Point, Ohio, on *Orthosoma brunneum,* July 31, (Brain).

Macrocheles sublævis n. sp.

Pale yellowish, tips of mandibles dark brown. Body little more than twice as long as broad, plainly constricted in front, broadest at middle, and broadly, evenly rounded behind; above almost smooth, with scattered short, simple bristles, about as in figure of the nymph, but the anterior ones are not thickened; a very short pair on the hind border. Front legs but little longer than the width of the body, last joint plainly longer than the preceding and slightly constricted on one side near the middle, tip with hairs longer than width of joint. Leg II heavy, third joint with a tooth below, with some stout spines; leg IV not reaching one-half its length beyond the abdomen, rather stout; two prominent spines on lip, not far apart; ventral shield with few short hairs; four bristles each side on the sternal shield and three each side on ventral shield, the last pair close to anus. Length .6 mm.

From Cedar Point, Ohio, on *Ligyrus relictus* and *Boletotherus bifurcus,* in June; nymphs on *Silphis surinamensis* larva.

Parasitus inæqualis n. sp.

Pale yellowish. Body about one and one-half times as long as broad, broadest in the middle, tapering behind and in front, with rather prominent shoulders; dorsal shield divided; anterior shield with six long bristles, two on humeri, and four on pos-

terior part of disc; two moderately large frontal bristles; other bristles small. A long, large bristle at tip of each femur of legs III and IV; tip of mandible with two slender bristles, last joint of palpus with a basal inner group or comb of stout bristles; legs I and IV about as long as the body; venter with stout spines, one in front and one behind on coxæ II and III, one on inner side of coxa IV, three each side and a frontal pair on sternal shield. Length 1.2 mm.

From Cedar Point, Ohio, August 6, on *Necrophorus orbicollis* (Brain).

TARSONEMIDÆ

Tarsonemus approximatus n. sp.

♀ Body large and broad; venter with two transverse lines near the separation of cephalothorax and abdomen. Three short bristles on each side, and a pair near tip of body; beak pointed in front. Legs short, but rather slender, with few hairs; tarsus I with a subbasal clavate hair, a long hair nearby, a pair near the tip above, and a clavate hair just before them; hind coxæ approximate, separated behind, but hardly by more than the width of a coxa; the terminal hairs not especially long. The male has the sides of body more parallel, the legs about as in the female, except the hind pair, which is thickened, but no tooth on the last joint, nor preceding joint; the claw very stout; the terminal hair fully twice as long as the last joint.

From Pomona, California, July 8, (Quayle), from under scale, *C. longulus*.

Tarsonemus assimilis n. sp.

In general similar to *T. approximatus*, but on tarsus I the bristles and clavate hairs are placed differently, as seen in figure. The body of female shows below apparently but one transverse line, which at middle has a median tooth with notch each side; the beak is pointed in front; the legs are rather stout, especially the anterior pairs; tarsus I is shorter than in *T. approximatus* and shows a subbasal clavate hair and long hair nearby. There is a large, fusiform hair at middle of the

joint, and two near tip, with one or two others nearer to tip. Coxæ III are more slender than in *approximatus,* the coxæ IV are close together as in that species, and the terminal hairs are very long.

From Whittier, California, September 7, (Quayle), from red scale. This and the preceding species, by their approximate hind coxæ, are related to *T. culmicolus* Reuter. Our other species have the tips of the hind coxæ more widely separated.

Disparipes apicola n. sp.

Pale yellowish brown. Body plainly longer than broad. From below, showing two bristles each side on the anterior part, the posterior bristle being the longer, and one each side near the humerus; a ventral pair of long bristles, and two pairs of poststernal bristles, the intermediate pair being placed more forward; also a pair of presternal, and three pairs of axillary bristles. On the posterior part of dorsum are two pairs of prominent thickened bristles, the posterior pair of which extends much behind the abdomen. Tarsi bristly, I and II with thickened process near tip above; leg IV with two very long bristles, three subequal shorter ones at tip, and two others still shorter and more basad, one on each side. Length .13 mm.

From honey bee, Guelph, Ontario, Canada, May 5, (G. J. Spencer).

CANESTRINIDÆ

Canestrinia blattophaga n. sp.

♀ Body broad, about one and one-half times as long as broad, without long bristles; a pair of short spines over base of mouth parts; a rather long bristle at humerus; a few short spines in pairs on the posterior dorsum, and four simple hairs on posterior margin. Venter with four spines each side on posterior part, and a pair at base of epimera of first legs; vulva V-shaped, with a transverse furrow behind it. Legs short; legs I and II heavier than the others, with only a few simple bristles; one at tip of penultimate joint is longer than others; a heart-shaped caroncle attached near tip of tarsi. Male with

more slender body and rather longer hind legs, but legs I and II are much stouter than in the female; the male aperture is lyre-shaped, and situated behind coxæ IV. There are four spines each side on posterior venter, the anterior pair being heavier than the others, and a pair between the bases of coxæ III. Length .7 mm.

From a cockroach (*Periplaneta americana*) Canal Zone, Panama, (Dr. Darling).

EXPLANATION OF PLATES

Figure 1. *Tarsonemus approximatus.* Male.
Figure 2. *Tarsonemus assimilis.* Female.
Figure 3. *Caligonus terminalis.*
Figure 4. *Tarsonemus assimilis.* Tarsus I.
Figure 5. *Tarsonemus approximatus.* Tarsus I.
Figure 6. *Disparipes apicola.*
Figure 7. *Caligonus terminalis.* Palpus, tarsus I.
Figure 8. *Disparipes apicola.* Tarsus I.
Figure 9. *Disparipes apicola.* Tarsus IV.
Figure 10. *Cheyletus cocciphilus.* Leg I.
Figure 11. *Tarsonemus approximatus,* and male tarsus IV.
Figure 12. *Parasitus inaequalis.*
Figure 13. *Parasitus inaequalis.* Lip.
Figure 14. *Macrocheles sublaevis.* Palpus, mandible, epistoma.
Figure 15. *Macrocheles sublaevis.* Legs I and II.
Figure 16. *Polyaspis lamellipes.* Mandible, leg I.
Figure 17. *Macrocheles sublaevis.* Lip.
Figure 18. *Bdella utilis.* Mandible, palpus.
Figure 19. *Canestrinia blattophaga.* Male, leg II, and venter of male.
Figure 20. *Canestrinia blattophaga.* Female.
Figure 21. *Cheyletus cocciphilus.* Palpus.
Figure 22. *Rhyncholophus moestus.* Head.
Figure 23. *Rhyncholophus moestus.* Leg I.
Figure 24. *Cunaxa armata.* Palpus.
Figure 25. *Macrocheles sublaevis.*
Figure 26. *Ophiomegistus luzonensis.* Male, leg IV.
Figure 27. *Rhyncholophus moestus.* Palpus.
Figure 28. *Ophiomegistus luzonensis.*
Figure 29. *Ophiomegistus luzonensis.* Ventral scales.
Figure 30. *Tetranychus simplex.* Palpus.
Figure 31. *Ophiomegistus luzonensis.* Male.
Figure 32. *Tetranychus simplex.* Tarsal claw.


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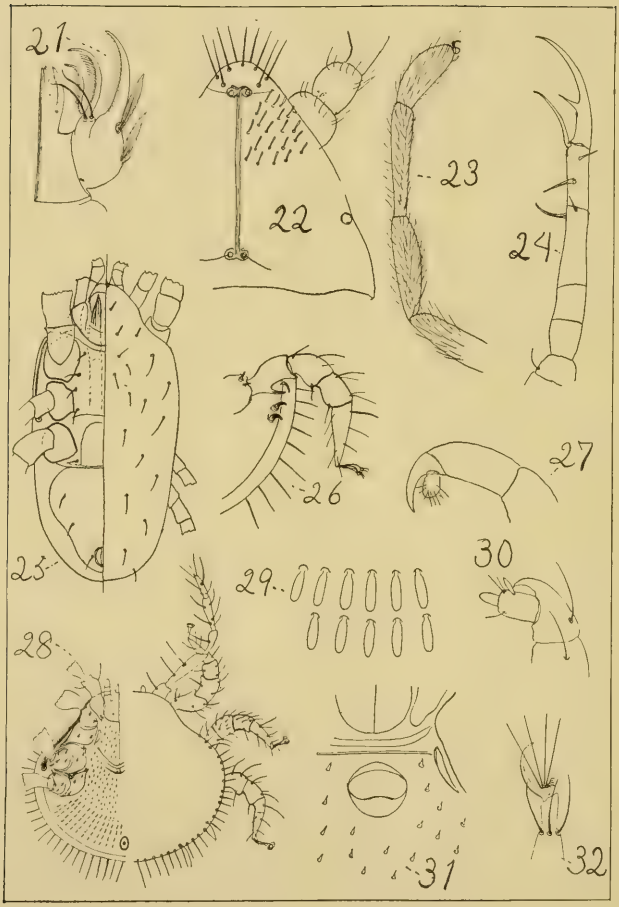
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Some Philippine Membracidæ

W. D. FUNKHOUSER*

Through the courtesy of Prof. C. F. Baker I have received the following interesting series of Membracidæ from the Philippine Islands. Eight genera including sixteen species are represented, of which one genus and six species are new. It is of interest to note that all of the forms belong to the Old World Centrotinæ which seems to be the dominant subfamily of Membracidæ in the Philippines as well as in eastern Asia.

I. *Pyrgonota bifoliata* Westw.

(Fig. 1)

1837 *Centrotus bifoliatus* Westw. Proc. Zool. Soc. 130.
1841 *Smilia bifoliata* Westw. Guer. Mag. Zool. Ser. 2. III. Ins. Pl. 83.
1846 *Hypsauchenia westwoodi* Fairm. Rev. Memb. 521. 2. Pl. 7. figs. 6, 7, 8,
1846 *Hypsauchenia bifoliata* Fairm. Rev. Memb. 521.
1851 *Hypsauchenia westwoodi* Walk. List Hom. B.M. 631. 2.
1851 *Hypsauchenia bifasciata* Walk. List Hom. B.M. 631. 3.
1870 *Pyrgonota bifoliata* Stal Hem. Phil. 731. 3.
1903 *Hypsauchenia westwoodi* Buckt. Mon. Memb. 211. Pl. 46. figs. 6, 6a.
1903 *Pyrgonota bifoliata* Buckt. Mon. Memb. 270.
1906 *Hypsauchenia bifoliata* Schmidt Stet. Ent. Zeit. 370.

Two specimens of this remarkable insect which is one of the most bizarre of the Membracidæ. There seems little doubt as to the identity of the *bifoliata* and *westwoodi* as recognized by Stal and the distinctive character of the pronotal horn would seem to warrant the retaining of the genus *Pyrgonota* as established by that author.

II. *Tricentrus Fairmairei* Stal.

1859 *Centrotus fairmairei* Stal Freg. Eug. resa Ins. 284. 192.
1866 *Tricentrus fairmairei* Stal Analect. Hem. 387.
1870 *Tricentrus fairmairei* Stal Hem. Phil. 728. 3.

* Contribution from the Entomological Laboratory of Cornell University.

1903 *Terentius fairmairei* Buckt. Mon. Memb. 271.

1905 *Taloipa tinctoria* Buckt. Trans. Linn. Soc. IX. 334. Pl. 22. fig. 4.

1907 *Tricentrus fairmairei* Dist. Fauna Brit. India 58. 2188.

A series of eight of this species without variation in coloration or venation. The two males are somewhat smaller than the females.

III. *Tricentrus convergens* Walk.

1851 *Centrotus convergens* Walk. List Hom. B. M. 623. 59.

1870 *Tricentrus convergens* Stal. Hem. Phil. 728. 1.

1907 *Tricentrus convergens* Dist. Fauna Brit. India 53.

Four specimens, two males and two females, which I determine as *convergens*. The males are very much smaller than the females and agree well with Walker's description which was founded on the male. The females, however, besides being much larger, are lighter in color and the horns are much more developed and wider apart at their extremities.

IV. *Tricentrus pilinervosus* sp. nov.

(Figs. 2 and 2a)

Near *Tricentrus decoratus* Dist. but differs in having the horns more elevated and the posterior process longer, much more acute and extending beyond the posterior angle of the inner margin of the tegmina.

Entirely black; densely, rather coarsely punctate; covered with long, silky, scattered grayish hairs. Hairs thicker and matted just below the horns. Horns extending upward, outward and slightly backward; as seen from above rounded before and almost straight behind. Posterior process very narrow and acute, reaching beyond the angle of the tegmina and bearing a strong median carina which extends anteriorly as far as the horns. Head black, densely punctate and pubescent. Ocelli slightly farther from each other than from the eyes. Eyes yellow. Tegmina fuscous-hyaline, black and punctate at base; costal and apical margin clouded; veins ferruginous and each bearing two rows of short bristly hairs; two discoidal cells. Legs blackish-ferruginous, tibiæ pubescent, tarsi lighter. Posterior trochanters strongly spined.

Type—Male.
Length, including tegmina, 6.5 mm.
Width between extremities of horns, 3.75 mm.
Habitat—Los Banos. Collected by C. F. Baker.

V. *Leptocentrus reponens* Walker.

1851 *Centrotus reponens* Walk. List Hom. B. M. 604. 14.
1859 *Centrotus antilope* Stal. Freg. Eug. resa Ins. 284. 191.
1870 *Leptocentrus antilope* Stal. Hem. Phil. 727. 1.
1885 *Leptocentrus reponens* Atkins. J. A. S. B. 54. 86.
1903 *Centrotus reponens* Melich. Hom. Ceylon. 110. 2.
1907 *Leptocentrus reponens* Dist. Fauna Brit. Ind. 30. 2138.
Three specimens, all female. No variation.

VI. *Centrochares horrificus* Westw.

1837 *Centrotus horrificus* Westw. Proc. Zool. Soc. 130.
1841 *Centrotus horrificus* Guer. Mag. Zool. Ser. 2. III. Ins. Pl. 82.
1851 *Pterygia horrificus* Walk. List Hom. B. M. 500. 9.
1852 *Pterygia horrificus* Walk. List Hom. IV. tab. 4. figs 4 and 5.
1866 *Centrochares horrificus* Stal. Analect. Hem. 386.
1870 *Centrochares horrificus* Stal. Hem. Phil. 731. 1.
1903 *Pterygia horrifica* Buckt. Mon. Memb. 73. Pl. 12. fig. 5.
1903 *Centrochares horrificus* Buckt. Mon. Memb. 266.
Three specimens. One male, two females. The male smaller and darker and with suprahumeral horns less expanded at tips.

VII. *Cryptaspidia pubera* Stal.

1870 *Cryptaspidia pubera* Stal. Hem. Phil. 729. 1.
1903 *Cryptaspidia pubera* Buckt. Mon. Memb. 267.
One specimen (female).

VIII. *Cryptaspidia tagalica* Stal.

1870 *Cryptaspidia tagalica* Stal. Hem. Phil. 729. 2.
One specimen (female).

IX. *Gargara varicolor* Stal.

1870 *Gargara varicolor* Stal. Hem. Phil. 728. 3.

A series of five specimens, one male and four females. The male is somewhat smaller and darker than the females and the latter show some slight variations in color, but Stal credits the species with several varieties and it seems evident that these gradate.

X. *Gargara nigro-fasciata* Stal.

1870 *Gargara nigro-fasciata* Stal. Hem. Phil. 729. 5.

One female which answers exactly to Stal's description of this species. The high carinated posterior process and the distinctively marked tegmina seem to sufficiently characterize the species.

XI. *Gargara pulchripennis* Stal.

1870 *Gargara pulchripennis* Stal. Hem. Phil. 729. 4.

One male and two females. The species is easily recognized by the dark tegmina decorated with stripes and numerous confluent white spots.

XII. *Gargara tuberculata* sp. nov.
(Fig. 6)

Entirely lemon yellow with very small scattered tubercles on pronotum. White line on each side of pronotum starting at median cephalic margin and extending backward over the shoulders in three branches, one of which passes under the humeral angle, one just above the angle and the third continuing over the angle to the notch at base of posterior process. A dark foveate spot on pronotum just above and slightly mesad of each eye. Head yellow, white tomentose below; ocelli farther from each other than from the eyes. Eyes brown with yellow margins. Posterior process set off from thorax by deep notch on each side at base; high median carina extends more obsoletely into thorax; extremity suddenly acuminate and brown at tip, just attaining angles of tegmina. Tegmina yellow opaque, base punctate and finely pilose; veins, except at base, thickly decorated with brown nodules. Entire undersurface of body white tomentose; sheath of ovipositor ferruginous. Legs yellow except bases of femora which are ferruginous.

Male smaller and slightly less tomentose below. Pronotal markings bluish.

Type—Female.

Length, including tegmina, female, 4.5 mm.; male, 4 mm.

Width at humeral angles, female, 2.5 mm.; male, 2 mm.

Habitat—Los Banos. Collected by C. F. Baker.

XIII. *Gargara luteipennis* sp. nov.
(Fig. 7)

Pronotum, wings and legs flat yellow. Head, front of pronotum and underparts of body ferruginous yellow. Pronotum finely punctate, not pilose. Very small dark foveate spot above each eye. Head very short, somewhat pubescent with yellow hairs; ocelli farther from each other than from the eyes. Eyes brown. Posterior process very slender and acuminate, slightly arched and just reaching internal angles of tegmina; obtuse median carina extending obsoletely through thorax. Tegmina yellow opaque, base punctate, veins yellow and each vein margined by narrow brown band finely punctate. Legs entirely yellow.

Length, including tegmina, 4 mm. Width between humeral angles, 2.5 mm.

Habitat—Los Banos. Collected by C. F. Baker.

Described from one female specimen.

XIV. *Gargara nitidipennis* sp. nov.

Pronotum ferruginous-brown before humeral angles, yellow behind; thickly and coarsely punctate, not pilose; broad dark foveate spot above each eye; broad light stripe over each humeral angle. Posterior process straight, closely impinging on tegmina and scutellum, extremity depressed and brown at tip, just reaching to internal angles of tegmina. Head black with yellowish pubescence; ocelli farther from each other than from the eyes. Eyes brown. Legs and underparts of body uniform ferruginous brown. Broad white tomentose patch extending across meso and metathorax from eye to beneath tegmina. Tegmina iridescent hyaline, base punctate.

Male somewhat smaller and darker and showing a clouded brown patch behind middle of tegmina.

Type—Female.

Length, including tegmina, female, 3.5 mm.; male, 3.33 mm.

Width at humeral angles, female, 1.5 mm.; male, 1.33 mm.

Habitat—Los Banos. Collected by C. F. Baker.

XV. *Sipylus nodipennis* sp. nov.

(Fig. 5)

Body subtriangular. Pronotum slightly wider between the humeral angles than the distance from the anterior convexity to the extremity of the posterior process. Body, legs and head uniform ferruginous brown covered with thick yellow pubescence. Head very short and broad; ocelli farther from each other than from the eyes. Eyes yellow. Pronotum convex, humeral angles strongly auriculate and wide at extremities; two large tubercules between humeral ears and extremity of posterior process, the first larger, the second darker in color; posterior process triangular, as broad as long, very obtusely ridged in the middle, not quite attaining the internal angle of the tegmina. Tegmina broad, rounded at apex, subhyaline, punctate at base, veins with very prominent brown nodules. Posterior trochanters armed with strong teeth.

Males smaller and darker in color.

Type—Female.

Length, including tegmina, female, 3.75 mm.; male 3 mm.

Width at humeral angles, female, 3.5 mm.; male, 2.75 mm.

Habitat—Los Banos. Collected by C. F. Baker.

Centrotoscelus gen. nov.

Scutellum distinct. Pronotum unarmed above lateral angles. Posterior process extending beyond the scutellum, impinging on scutellum and tegmina, slightly concave before extremity and reaching just beyond the internal angles of the tegmina. Hind wings with three apical areas. Posterior trochanters armed with teeth on the internal margin. Body much longer than wide.

This genus seems to stand between *Tricentrus* Stal and *Gargara* Am. and Serv. It is to be distinguished from the former genus by the absence of horns above the humeral angles, and from the latter by the presence of armed trochanters. In shape of body and general facies it most resembles the larger forms of *Gargara* but this latter genus has been distinctly limited to those forms which have the posterior trochanters unarmed.

The genus is established to admit the following species of which I have both male and female specimens.

XVI. *Centrotoscelus typus* gen. nov., sp. nov.
(Figs. 3 and 4)

Ferruginous-brown; pronotum finely and densely punctate and sparsely covered with grayish hairs. Pronotum convex, highest above lateral angles; lateral angles obtuse. Posterior process long, narrow, gradually acuminate, somewhat concave before extremity, slightly depressed at tip, extending somewhat beyond internal angles of tegmina; median ridge distinct at apex and becoming obsolete in thorax. Head short, broad, densely pilose with long grayish hairs. Antennæ prominent. Ocelli farther from each other than from the eyes. Eyes brown with darker fascia. Tegmina subhyaline, brown and punctate at base, very narrow brown transverse stripe behind middle and faint brown cloud at apex. Legs ferruginous, tarsi yellowish, claws black. Segments of abdomen margined with white above.

Male smaller, darker, markings of tegmina more prominent especially the brown cloud at apex.

Type—Female.

Length, including tegmina, female, 5 mm.; male 4.33 mm.

Width at humeral angles, female, 2.5 mm.; male 2.2.

Habitat—Los Banos. Collected by C. F. Baker.

EXPLANATION OF PLATES

Figure 1. *Pyrgonata bifoliata* Westw.
Figure 2. *Tricentrus pilinervosus* sp. nov.
Figure 2a. *Tricentrus pilinervosus* sp. nov. Cephalic view.
Figure 3. *Centrotoscelus typus* sp. nov.
Figure 4. Hind trochanters *Centrotoscelus typus.*
Figure 5. *Sipylus nodipennis* sp. nov. Dorsal view.
Figure 6. Fore-wing *Gargara tuberculata* sp. nov.
Figure 7. *Gargara luteipennis* sp. nov. Cephalic outline.

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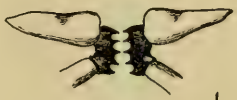

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The Second Protodiaspis

E. O. ESSIG
SECRETARY STATE COMMISSION OF HORTICULTURE, SACRAMENTO, CAL.

Protodiaspis agrifolia n. sp.

(Figs. 1-3)

In the year 1910 this coccid was discovered on the coast live oak (*Quercus agrifolia*) in the Santa Paula Canyon (500 feet altitude), near Santa Paula, Ventura County, California, by S. H. Essig, brother of the writer. Material was forwarded to Professor T. D. A. Cockerell, who placed it in the genus *Protodiaspis*, and who advised me to send specimens on to Dr. C. L. Marlatt for comparison with the type specimens of *Protodiaspis parvula* Ckll. Dr. Marlatt informed the writer that it proved to be a new species. In part he states: "Your No. 5 on *Quercus agrifolia*, collected at Santa Paula and Claremont, evidently belongs to Prof. Cockerell's *Protodiaspis* and seems to be a new species. The scale is a little more definitely formed than any *Protodiaspis*. The insect comes very close in general features to *Protodiaspis parvula*, but differs in some important details."

In the year 1911 the writer took specimens of this coccid on *Quercus agrifolia* on the Pomona College Campus, Claremont, California, where it occurs in abundance. Some of these specimens were also sent to Dr. Marlatt. Some mounted specimens were sent to Prof. Geo. A. Coleman, March 12, 1913, who wrote under date of March 17, 1913, as follows: "I have examined the coccid taken on oak at Santa Paula, and find that it belongs to the genus *Protodiaspis*."

In preparing this description the writer desires to acknowledge the valuable assistance of the persons referred to above and also the aid of Mr. Leroy Childs, Assistant Secretary of the State Commission of Horticulture, for the many suggestions, particularly with regard to the anatomical characters, which are so obscure. The species is so small and the scales so obscure that it has been found difficult to make a perfectly satisfactory description.

FEMALES

Scales—The exuviæ of the female scales are comparatively large—almost entirely covering the bodies. They vary from light yellow to dark reddish-brown in color and are central or sub-central. The length averages about 0.4 mm. The scale or shell proper is rather thick and brittle and has a well developed

Figure 1. *Protodiaspis agrifolia.* Twig of *Quercus agrifolia,* showing characteristic infestation of females. (Original).

ventral or under shell beneath the body. It is very small and not easily seen without the aid of a hand lens (Fig. 1). The color is light gray and conforms well with the color of the oak bark. Each scale is constructed around and includes the many

forked leaf and bark spines of the oak. The shape is oblong oval, the length being from 0.8 mm. to 1 mm. The width is slightly more than half the length.

Bodies—The bodies of the mature females are oval in shape (Fig. 3, D), being noticeably wider near the anterior end. The

Figure 2. *Protodiaspis agrifolia.* Male scales on the underside of an oak leaf. (Original).

length is about 0.5 mm. and the width 0.3 mm. Some are larger and not a few considerably smaller. The mouth parts are exceedingly large for the size of the insect—the rostral loop

varying from one-third to nearly the full length of the body. The four spiracles are plainly seen near the mouth parts. There may be several gland openings near the stigmatic orifices. Two rudimentary antennæ are present at the anterior end. The pygidium is rather wide and regularly rounded. There are no distinct lobes in the mature forms, though the margin may be uneven. (Fig. 3, A). In some of the cast skins of the young

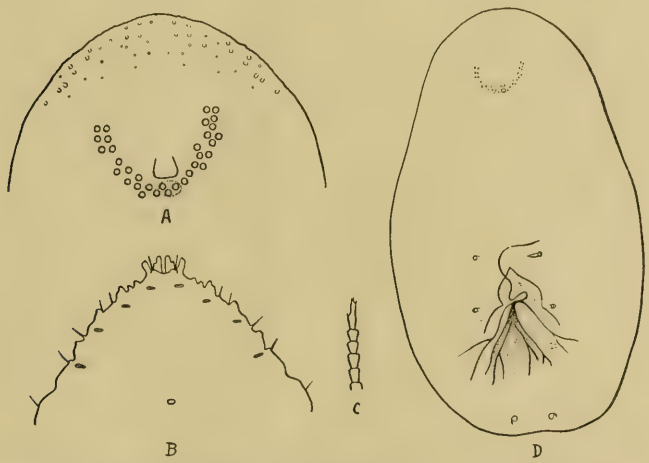


Figure 3. Anatomical characters of *Protodiaspis agrifolia*. A, pygidium of mature female; B, pygidium of cast skin of an immature female; C, antenna of young; D, outline of body of mature female. (Original).

(the bodies could not be obtained) the pygidium is distinctly lobed. (Fig. 3, B). There are two median lobes, two distinct second lobes and three other projections or rudimentary lobes. In speaking of these Prof. Coleman writes, "I cannot think, however, that it is *P. parvula*, as according to Cockerell's description of that species it is very small, about 0.5 mm., while this is 0.75 mm. or more; also he says *parvula* has four very low rounded lobes, while this has four—the middle of which are broad and rather prominent—the first laterals are rather long,

curve inward on the inner margin and are notched on the outer, and I make out also a third small pointed lobe a little distance from these on either side. *P. parvula* he says has no spine-like plates, while I find three on each side in this." In the moults the spines and lobes are lost. The shell glands are very small and so hard to detect through even the high power of the microscope that their positions are not as accurate as desired. The circumgenital glands are very distinct and arranged in an almost unbroken crescent anterior to the genital opening. The number is variable—from twenty-one to thirty-three in two individuals. In some individuals the body segmentation is very distinct, while in others, as in Figure 3, D, there are no noticeable divisions. From nine to thirteen segments have been counted in various individuals.

The females are usually found upon the bark of the previous year's growth and upon the leaf petioles. They are so small that one should first look for the roughened bark to locate an infestation.

YOUNG

The young have not been obtained but cast skins of several stages have been mounted with the other material. The pygidium of one of these has been referred to above and is illustrated in Figure 3, B. The antennæ of several skins prove to be six-articled as shown in Figure 3, C.

MALES

Scales—The exuviæ of the males are yellow and their position is somewhat distant from the anterior end. The scales are little more than fluffy, snow-white cocoons, made of fine white cottony material which is arranged in an oblong cylindrical-like mass and attached to the leaf and bark hairs of the host. There are no visible carinæ or markings of any kind. Figure 2 is slightly enlarged and shows these scales very well. They are very small, being about 0.6 mm. long and 0.2 mm. wide, and are located on the undersides of the leaves and upon the younger twigs of the oak. Though small they afford a ready means of locating the scale.

The adult males have not been observed.

A Pseudoscorpion from Poplar Trees

MARGARET LYONS MOLES

Chelanops paludis n. sp.

Measurements—Length of animal, including mandibles, 3 mm. Length of palps 3.5 mm. Length of claws 1.5 mm. Width of largest part of abdomen 2.5 mm. The whole animal is nearly as broad as it is long.

Color—Cephalothorax dark reddish brown. Palps reddish brown. Legs pale yellowish brown. Abdomen pale yellowish brown with reddish brown spots.

Cephalothorax—Slightly longer than it is broad. Front margin evenly rounded, sides convex and lower margin of a broad "V" shape. One distinct suture whose outer edges curve toward the front margin.

Abdomen—Nearly as broad as it is long, divided into parallel distinct sutures. The scuta are distinct at the center of the abdomen but towards the edge of the body grow indistinct. This is due to the fatness of the abdomen. Each plate has two dark spots of color which are fringed on the sides and bottom edge with ten stout clavate hairs.

The whole body is finely granulate and covered with stout clavate hairs. These so-called "clavate hairs" have not the true knob, but are fringed at the end.

Pedipalps—Length 3.5 mm. Longer than the whole animal. Coxa smooth, trochanter as usual. Femur shorter than cephalothorax, pedicellate, broadest near the base, concave on inner margin near the tip. Tibia shorter than femur, strongly convex on outer edge, strongly convex on inner side near base and beyond strongly concave, pedicellate. The trochanter, femur and tibia are finely granulate and covered with short clavate hairs.

Claws—Short and stout, as long as cephalothorax, fingers stout and not strongly curved. Hand evenly and strongly convex on inner side, not so strongly convex on outer side, yet

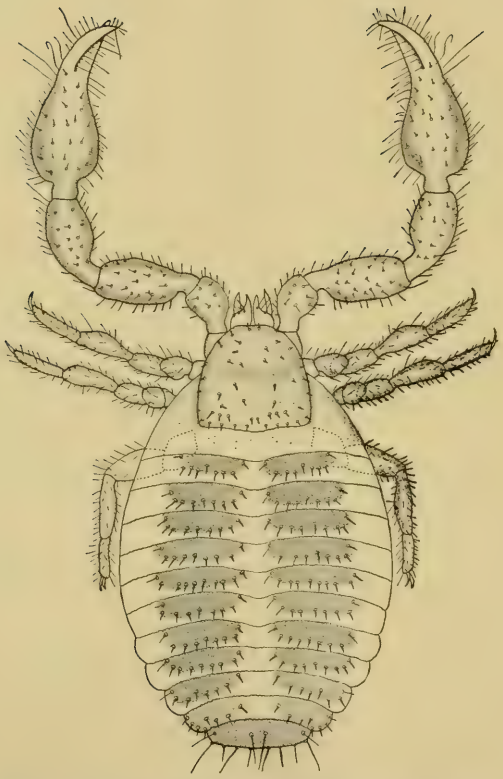


Figure 1. *Chelanops paludis* n. sp. Last pair of legs not shown.

evenly convex. Hand slightly granular and covered sparsely with short clavate hairs. The fingers are smooth with many long simple tactile hairs.

Mandibles—Small for size of animals, the fixed finger provided with many teeth. Serulla attached throughout length of moveable finger. Spinnerets short and knob-like. Mandibles have six long simple hairs.

Legs—Each with a trochanter, claws double with a membrane between the claws. Legs covered with short clavate hairs.

Eyes—None.

Habitat—On poplar trees in Chino Swamp. Found in rotten poplar log and live poplar trees.

(Contribution from the Zoological Laboratory of Pomona College.)

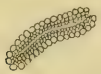
A New Species of Tullbergia

GERTRUDE A. BACON

This new species of Tullbergia so far has only been found in the hills and a number of specimens were taken near Pomona and Laguna Beach. They are easily distinguished by their long and slender bodies. This is the first time this genus has been recorded from the United States.

Figure 1. *Tullbergia* collis n. sp. Dorsal view.

Figure 2. *Tullbergia* collis n. sp Side view.



D

F

E

G

Figure 3. *Tullbergia.* D, postantennal organ; E, leg and claw; F, setæ; G. anal horns.

Tullbergia collis n. sp.

Length—1.5 mm. *Width*—.3 mm. *Color*—White. *Body*—Long and slender, sparsely covered with short straight hairs,

only two or three to a segment except at the posterior end, where there are numerous long, straight bristles; segments somewhat fused; finely granular. *Antennæ*—Shorter than head, segments subequal. *Eyes*—Wanting. *Postantennal organ* (Fig. 3, D)—Present, consisting of a transverse groove with four rows of tubercles with more than twenty in each row; around the outside in some of the specimens there is a band of modified tubercles which surround the organ. *Pseudocelli* (Fig. 1)—Present, one at the base of each antenna, two on posterior end of head, two on each segment of the body except the last one. *Legs* (Fig. 3, E)—Short, stout, with one stout claw slightly curved. *Anal horns* (Fig. 3, G)—Two, situated on papillæ which are separated at the base; longer than the papillæ and about the same length as the claw.

(Contribution from the Zoological Laboratory of Pomona College.)

Some Notes on the Distribution of Cinura in the Vicinity of Claremont, with Description of a New Species

RAY EARL GARDNER

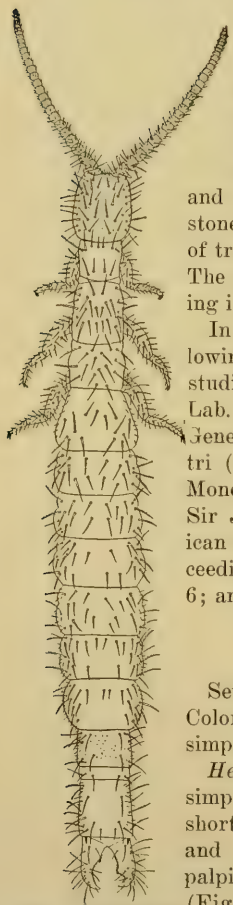


Figure 6. *Evalljapyx propinquus*, F. Silvestri.

Most of the specimens were found in the canyons in the mountains north of Claremont. *Campodea* and *Japyx* were obtained from damp, decaying vegetation, under leaves and sticks and under rocks. Machilis and Lepisma were also found under leaves and stones, only in dryer places and under the bark of trees. All specimens were preserved in alcohol. The Campodea were studied in detail after boiling in KOH.

In the determination of these forms the following works were consulted: Material per lo studio dei Tisanuri F. Silvestri Bollettino del Lab. di Zool. Gen. e Agraria, Vol. V, 1911; Nuovi Generi e Nuove specie di Campodea by F. Silvestri (Bull. del Lab. di Zool. Gen. e Agr., 1912); Monograph of the Collembola and Thysanura, by Sir John Lubbock, London, 1873; North American Apterygogenea, by Harold Schoett, in Proceedings of California, Academy of Science, Vol. 6; and a large number of others.

Campodea montis n. sp.

(Figs. 1-2)

Several specimens of this species were studied. Color white. The smaller setæ of the body are simple, while the larger are well serrated.

Head—The head is covered with numerous, simple short setæ. There is a single row of stout short hairs at the base of the head, truncated and slightly plumed. The surface of the labial palpi more than one-third wider than long. (Fig. 2, A). The antennæ have thirty or more

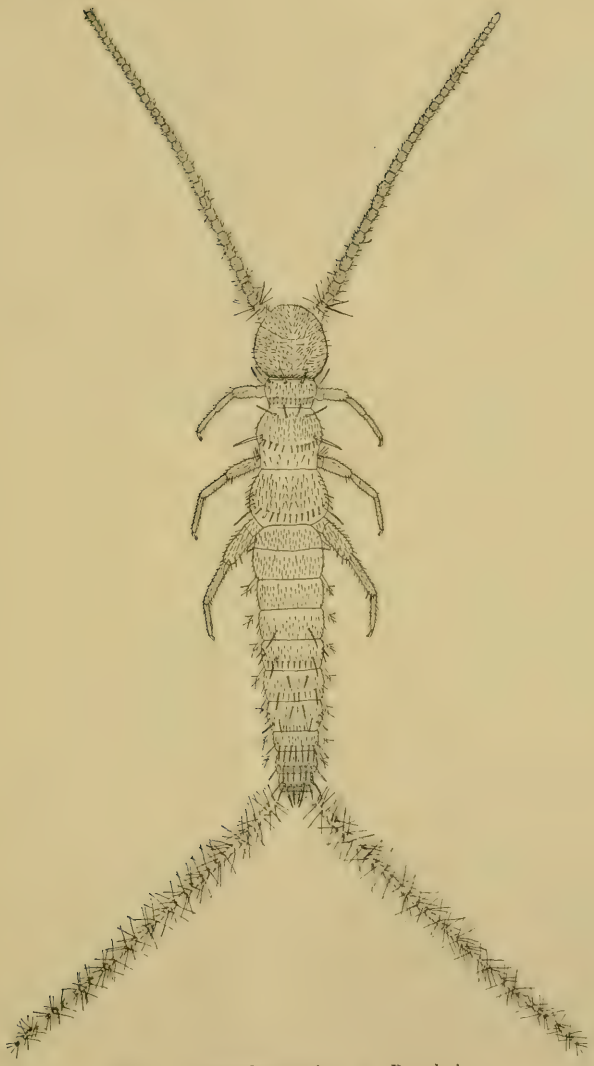


Figure 1. *Campodea montis* n. sp. Dorsal view.

joints with numerous short simple setæ, with some serrated. The terminal joints of the antennæ are often small, as if recently grown out.

Thorax—The smaller hairs are simple and the larger macrochætæ are longer and serrated. *Pronotum*—There are three pairs of long strong macrochætæ on the pronotum. The longest pair on the cephalic lateral margin. The other two pairs of

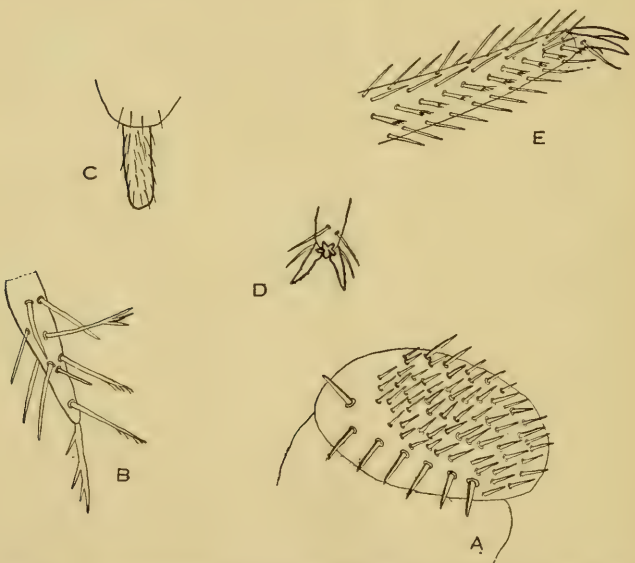


Figure 2. *Campodea montis* n. sp. A, labial palpus; B, stilus; C, first abdominal appendage; D, under side of foot; E, tibia and claws.

hairs on the cephalic border are not as long as the above. On the rear margin of the pronotum there is a row of short, very thick setæ with flattened points and saw-shaped. *Mesonotum*—Here there are three pairs of long serrated macrochætæ. The longest ones are on the caudal lateral border and are about as

long as half the width of the mesonotum. The next long pair of macrochætæ is on the cephalic border and is two-thirds as long as the above. The two medial macrochætæ are half as long as these. *Metanotum*—Only one pair of long macrochætæ on the caudal border. A row of short strong setæ between these two macrochætæ.

Abdomen—First, second and third abdominal terga are without long hairs. The fourth has one pair of long caudal

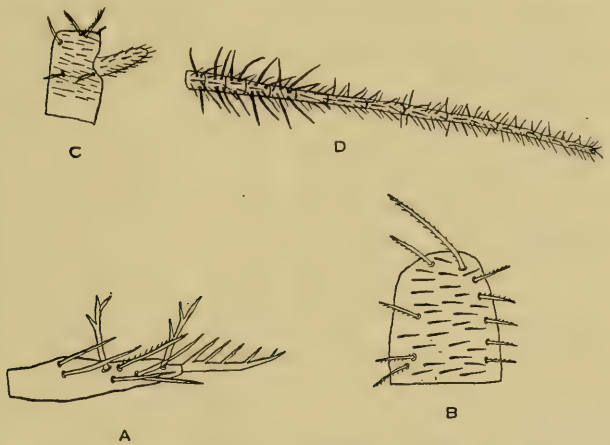


Figure 3. *Campodea kelloggi.* A, stilus; B, pronotum, dorsal view of one-half; C, first abdominal appendage; D, cercus.

macrochætæ. The fifth tergite has a pair of long macrochætæ and a number about two-thirds as long. The sixth has two and seventh has three pairs of long macrochætæ on each side. The eighth, ninth and tenth terga have eight or nine macrochætæ.

Feet—Two claws and no appendages but hairs on the claws. Femur without hairs on the lower side and about fourteen rows of short simple hairs on the upper side. Tibia, about twenty hairs in a row on the upper side. Tarsus short, simple,

with strong pointed hairs all the way around. There is one row of short, strong plumed setæ (Fig. B). There is a little pad on bottom of foot (Figs. E & D).

Cerci—Nearly as long as abdomen and thorax. They have fourteen joints. They are covered all the way down with quite long and strong setæ, some of which are serrated.

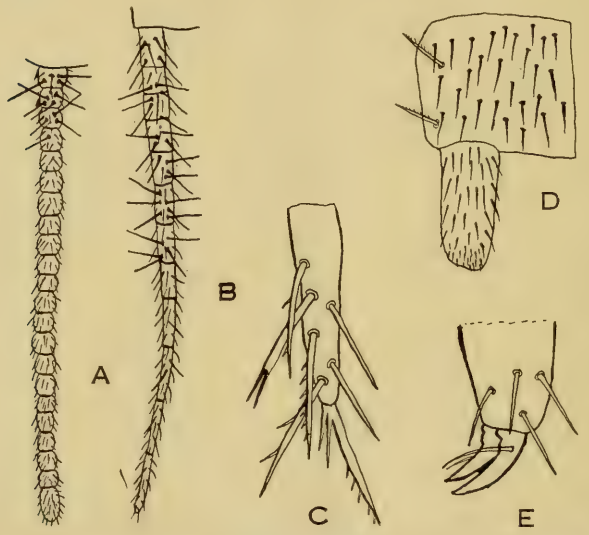


Figure 4. *Campodea folsomi.* A, antenna; B, cercus; C, stilus; D, first abdominal appendage; E, claws.

Length of body, including head, 5 mm. Width of thorax, 1 mm. Length of cerci, 4 mm. Length of antennæ, 4 mm.

This species I first found in Cucamonga Canyon, northeast of Claremont, under oak leaves in damp earth; later it was found in the hills south of Pomona.

This species resembles *Entrychocampa wilsoni,* described by F. Silvestri. However, it differs very distinctly from this form in that it does not have the large lateral appendices of the

claws. The cerci and antennæ are much longer, and the stylus is distinct.

Campodea kelloggi F. Silvestri

(Fig. 3)

This species was found in nearly every canyon in the mountains north of Claremont, in Cucamonga, San Antonio, Palmer's, Live Oak and San Dimas, and also in the South Hills below Pomona.

My specimens of this species seemed to vary a little from that described by F. Silvestri. The stylus differed slightly and the pronotum had five long macrochætæ, instead of three (Fig. 3, B).

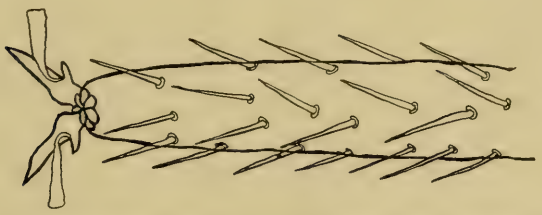


Figure 5. *Entrychocampa wilsoni.* Tip of foot, showing large appendages on the claws and the pad between the claws.

Campodea folsomi F. Silvestri

(Fig. 4)

This species was collected for me by Dr. Hilton from Live Oak Canyon. Although this appears to be almost a distinct form, still it resembles *Campodea folsomi* closely and may at present be termed a variation of this species. The claws (Fig. 4, E) are practically the same as *C. folsomi,* but the stilus (Fig. 4, C) differs slightly in that there are more serrations on the hairs. The cerci differ in that there are twelve or thirteen joints, instead of eleven. The antennæ (Fig. 4, A) differ in that there are twenty-two joints, instead of nineteen. The first abdominal appendage (Fig. 4, D) is slightly different in shape, longer, and not so wide.

Entrychocampa wilsoni F. Silvestri

This species I found in Cucamonga and San Dimas canyons, and in the South Hills. It is easily distinguished from the others, because of the lateral appendices on the claws (Fig. 5). One noticeable feature which is shown in the figure is the flower-like organ on the bottom of the foot (Fig. 5).

Fam. JAPYGIDÆ

Evalljapyx propinquus F. Silvestri

(Fig. 6)

This species was found in nearly every canyon in the mountains, in Cucamonga, San Antonio, Palmer's, San Dimas, and Live Oak canyons, in Blanchard Park and in the South Hills. It is determined by its forceps. The base of the right is broader than the left. About one-third of the way down on the left is a large tubercle. About two-thirds of the way down on the right there is a large tubercle. From this tooth to the tip it is greatly concave. There are about eleven teeth on the inner side of each of the forceps (Fig. 6).

Fam. LEPISMIDÆ

I have several species of the genera Lepisma and Machilis which are not yet determined. Most specimens were found under dry leaves and stones. One species of Lepisma was found on a sycamore tree under the bark.

(Contribution from the Zoological Laboratory of Pomona College.)

Aplonyx Sarcobati N. Sp.

E. P. FELT
Albany, New York

The small midges described below were reared in numbers December 23, 1913, from oval swellings on the leaves of grease wood (*Sarcobatus vermiculatus*) collected at Canyon City, Colorado, November 23, 1913, by Prof. Ellsworth Bethel. The galls were apparently abundant and contained orange yellow larvæ. Recently emerged females have the abdomen filled with some fifty or more narrowly oval eggs. It is remarkable that this peculiar type, first discovered in the Mediterranean region, should be represented by a close ally on the plains of Colorado.

Male—Length 1.3 mm. Antennæ extending to the third abdominal segment, sparsely haired, dark brown; twelve sessile cylindric segments, the third and fourth rather narrowly fused, the fifth with a length three-fourths its diameter, the terminal segment with a length over three times its diameter, broadly rounded apically and composed of three closely fused segments. Palpi—The first segment short, irregular, the second broadly oval, both sparsely setose. Mesonotum dark brown. Scutellum and postscutellum fuscous yellowish. Abdomen dark brown, the basal and terminal segments yellowish orange, the genitalia fuscous yellowish. Wings hyaline, costa yellowish brown, thickly scaled, subcosta uniting therewith near the basal half; the fifth vein simple, uniting with the posterior margin at the distal third, the sixth at the basal third. Halteres, coxæ, femora and tibiæ fuscous yellowish, the tarsi dark brown. Claws moderately stout, strongly curved, simple, or at most, very minutely toothed, the pulvelli as long as the claws. Genitalia—Basal clasp segment long, moderately stout; terminal clasp segment swollen basally, with a length about half that of the basal clasp segment and with a distinct apical tooth; dorsal plate rather long, broad, broadly and roundly emarginate, the lobes somewhat divergent and narrowly rounded; ventral plate long, moderately broad and broadly rounded. Harpes long,

slender, slightly curved and tapering to a subtruncate, spinose apex; style moderately long, slender, tapering, narrowly rounded apically.

Female—Length 1.5 mm. Antennæ hardly extending to the base of the abdomen, sparsely haired, dark brown; fourteen sessile segments, the fifth with a length one-fourth greater than its diameter, the terminal segment with a length more than thrice its diameter and composed of three closely fused segments. Palpi—First segment broadly ovate, the second slender, with a length about thrice its diameter. Mesonotum shining dark brown, the submedian lines thickly white-haired. Scutellum and postscutellum fuscous yellowish. Abdomen dark brown, the segments narrowly margined posteriorly with silvery white, the markings on the first two rudimentary, those on the third, fourth, fifth and sixth almost forming submedian spots, those on the seventh diffuse; venter with the small sclerites dark brown, the incisures and pleuræ fuscous yellowish. Ovipositor yellowish, nearly as long as the abdomen when extended, the basal portion fleshy, the distal third chitinized, cultrate and with a distinct expansion near the middle. The claws in this sex are distinctly heavier than in the male and about as long as the pulvilli.

Type—C. a2477.

This unique type is most interesting because of certain synthetic combinations, namely, the Lasioptera type of wing and antenna with the simple claws and the bladelike ovipositor, the two latter suggesting very strongly an affinity with Asphondylia. In the case of the ovipositor we believe this modification to be one of minor significance and evidently an adaptation enabling the female to deposit her eggs within the tissues of the host plant. The absence or almost total absence of teeth on the claws is simply one remove further from what we find in Baldratia with claws either simple or toothed. The combination of characters is significant and yet the obvious dominance of the Lasioptera structures leads us to class this genus with the Lasiopteraria rather than to place it in a separate tribe, Aplonyxini, as proposed by Dr. Perez, the discoverer of Aplonyx.

The Nervous System of *Neanura Gigantia* Tulb

WILLIAM A. HILTON

The fortunate chance to study these large Collembola led to an examination of the nervous system. A number of large specimens were dissected, but with rather meager results for although the body was soft it was difficult to separate the internal organs. However, even older specimens were easily sectioned and a number of perfect series were obtained.

The nervous system seemed to be of the same general type already studied in linear Collembola, but one marked difference

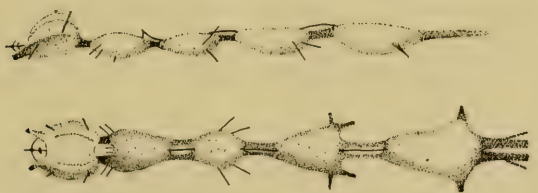


Figure 1. Side and dorsal view from a wax reconstruction of the nervous system of *Neanura gigantia*, X50. Not all specimens give the same relative position for the two head ganglia. The position of these may depend somewhat upon the position of the soft body of the animal.

was noted; the small size of the nervous system as compared with the size of the animal. These forms were less active than other Collembola examined.

The supraesophageal ganglion has three nerve trunks, the largest, the antennal, is the first pair; the small labral nerves come from the cephalic ventro-lateral portion of the brain. The ocular nerves are from the dorso-lateral portions of the ganglion. The subesophageal ganglion has two minute branches from its anterior margin between the connectives, these may be gustatory nerves. Next caudally are two lateral pairs of nerves corresponding to mandibular and maxillary trunks and back of these is a ventral pair which may be homologous with labial nerves.

The first and second thoracic ganglia each have two pairs of nerves. The last ganglion has a large lateral pair of nerves and two terminal ones which run back a considerable distance to the end of the body and give off branches.

Other ganglia and nerves which may be parts of the so-called sympathetic system are as follows:

There is a small frontal ganglion, its posterior branches probably connect with the brain but the connections were not seen. Back from this ganglion a small nerve follows the intestine and at one place seems to give rise to lateral nerve centers on the wall of the intestine. Running dorsally from the dorso-caudal end of the subesophageal ganglion is a very small median nerve; it runs dorsally and then back to the first part of the first thoracic ganglion. Between the next two ganglia there are similar median nerves. A few slight fibers from these seem to go to the intestines. Oudemans '87 in *Machilis* figures a similar nerve and branches from it are spoken of as going to spiracles. *Neanura* has no spiracles.

In several species of Collembola studied in 1913 and 1914 I have found no indication of such median nerves, but it is possible that they were present and not seen in the smaller and less favorable species. This median trunk in various conditions has been figured in a number of species in recent times by Hammar '08, and by Haller '10, but I have seen no mention of it in Collembola.

Some of the chief points in this study are as follows:

1. The central nervous system is small in proportion as compared with other Collembola.
2. A small frontal ganglion and two small intestinal ganglia were recognized.
3. Median nerves run between all the ganglia but the first two.
4. The brain seems made up of three ganglia fused, the subesophageal ganglion seems composed of several fused parts and the last ganglion seems composed of four or more distinct parts.

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(Contribution from the Zoological Laboratory of Pomona College.)

Shorter Articles

J. J. RIVERS

James John Rivers was born in Winchester, England, January 6, 1824, and died at his home in Santa Monica, California, the morning of December 16, 1913, at the ripe age of nearly ninety years. His wife and life-long companion died only a few months before, in May, and it was doubtless this shock which hastened the death of the oldest of the Californian naturalists. He left no near relatives so far as known.

Not much is known of his early life; his parents and brothers all died when he was young, and he was left in care of an aunt, from whom he inherited considerable wealth. He was a cousin of Sir John Rivers. J. J. Rivers studied medicine at the University of London, coming under the influence, there, of Thomas Henry Huxley, whom he greatly admired. He attended Faraday's lectures and became acquainted with Charles Darwin, so it is not to be wondered at that the young man became an enthusiastic naturalist. He graduated from London about 1850 and entered Trinity College, Cambridge, as a student in zoology. His favorite sport at this time was cricket, playing on his aunt's meadow. At Dorking he was apprenticed to a pharmacist, and later went to London again, entering the office of a Dr. Powers, who was a coleopterist. Rivers attended the meetings of the Entomological Society of London and met at these gatherings, Stainton, Douglas, and Robert McLachlan, at whose house he lived for a time. He knew Francis Walker of the British Museum, and T. Vernon Wollaston, the student of the natural history of the Madeiran Islands. These and other noted naturalists he knew and associated with, and in later years could relate many interesting anecdotes to his young naturalist friends. He became acquainted with G. R. Crotch, who was in California in the 70's, and Janson of London was his ideal as a preparator of Coleoptera.

He lived and collected in Devonshire for a number of years after leaving London, where Crotch visited him in the 50's. He also collected in Cornwall, North Devon and other places.

He left England about 1867 for the United States, settling first in Junction City, Kansas; was associated with the late Dr. Snow at the University of Kansas. He was in Denver for a short time and about the middle of the seventies came to Berkeley, and became a Californian naturalist for the remainder of his life. He became acquainted with all the scientists of the State and played leading parts in all the various activities, including the California Academy of Sciences. He was one of a little group of naturalists, including Behr, Behrens, Stretch, Harford, Lockington and others, which met informally and was known as the Arthrozoic Club.

Rivers was Curator of Organic Natural History in the University of California until he resigned, about 1895, and removed to Ocean Park and Santa Monica, where he resided until his death. Prof. Rivers, as he was generally and affectionately called, ranged over nearly the whole of the natural sciences; he was a representative of the old-time naturalists. He studied and published papers on living and fossil shells, Lepidoptera, Coleoptera, spiders, and reptiles, and collected plants. His published papers are mostly in the Proceedings of the California Academy of Sciences, Bulletin of the Southern California Academy of Sciences, Zoe, Papilio and Entomological News. The titles of some of these will give some idea of his scientific work: Habits in the Life-history of *Pleocoma behrensii*; a Miocene Shell in the Living State; Description of the Nest of the California Turret-building Spider with Some References to Allied Species; The Species of Amblychila; Chariessa lembertii; the preceding all in Zoe. A New Genus and Species of North American Scarabæidæ and a New Species of Californian Lepidoptera, in the Proceedings of the California Academy; and in the Bulletin of the Southern California Academy of Sciences: Butterfly Emigrants; Discovery of Another Foodplant of *Uranotes melinus*, Hueb.; A Butterfly New to Southern California; The Caterpillar Plague; *Euvanessa antiopa*, and other papers. His last paper, with a photographic plate, was published in the Bulletin of the Southern California Academy in July, 1913, being, A New

Species of Bathytoma from the Upper Pleistocene of San Pedro, California.

Rivers' fine collection of Coleoptera, which contained a number of types and specimens from Horn and LeConte, was sold to Walter Horn of Berlin, Germany, several years ago. In the Lepidoptera, he made a special study of the genera *Melitæa* and *Clisiocampa,* describing a new species of the former. His collection of shells was acquired, in part, by Pomona College, Beloit College (Wisconsin), and Dr. F. C. Clark of Santa Monica.

Of greatest value, greater than his published work and collections, was the influence of his personality on those who were privileged to have known him; that cannot be expressed in words. He was a real naturalist and to have known him was a great privilege. His little workshop and museum behind his house, filled with books and specimens, will always be remembered by those who were ever in it.

Fordyce Grinnell, Jr.

Pasadena, California.

THE TENTH CALIFORNIA KERMES

GEO. B. KING
Lawrence, Mass.

Kermes branigani n. sp.

(Fig. 1)

Female scale—Globular in shape, 5 mm. long, 6 mm. wide, 5 mm. high. The color is light cream, nearly white, often with bluish cast, with four broad transverse bands of very light yellowish brown. Segmentation distinct; the sutures slightly depressed and marked by small round black dots. Surface shiny and thickly covered with minute black specks, which are seen only through a hand lens. There is a short, very distinct groove posteriorly reaching to the anus.

This is a very pretty species and is closely allied with such species as *Kermes galliformis, Kermes occidentalis, Kermes nigropunctatus* and *Kermes essigii.* It is nearest to the latter

and if gibbose would have been described as a variety of *Kermes essigii.*

Taken on the smaller branches of a single large maul oak, *Quercus chrysolepis* Liebm., at the Bath Mine, Volcano Canyon, Sierra Nevada Mountains, altitude 3,500 feet, near Forest Hill, Placer County, California, by E. J. Branigan and E. O. Essig, November 22, 1913. The material was sent to me by Mr. Essig and I take pleasure in naming it after Mr. Branigan, who discovered the first specimen.

Figure 1. *Kermes branigani* King, on twigs of maul oak, *Quercus chrysolepis* Liebm. (Photo by E. O. Essig).

The highest altitude at which a species of Kermes has been taken is in the case of *Kermes gillettei* by Prof. Cockerell at Beulah, New Mexico, at about 8,000 feet. Mr. Essig has recently taken *Kermes cockerelli* at Colfax, California, at an altitude of 2,500 feet.

Wants and Exchanges

Subscribers and others are urged to use these columns to make their wants known. As the Journal goes to all parts of the world we hope to make this a very useful feature of the publication. Exchange notes are free to subscribers.

WANTED—Myriopods from all parts of the world. Will name, exchange or purchase. R. V. Chamberlin, Mu. Comp. Zoology, Harvard Univ., Cambridge, Mass.

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Biology of the North American Crane Flies (Tipulidæ, Diptera)

II. *LIOGMA NODICORNIS* Osten Sacken

CHARLES PAUL ALEXANDER
ITHACA, N. Y.*

The genus *Liogma* belongs to the tribe *Cylindrotomini,* an interesting group of the Tipulidæ. Baron Osten Sacken in the Monographs of the North American Diptera speaks of them as a "small, but very remarkable group of species, occupying an isolated and intermediate position between the *Tipulidæ brevipalpi* and *longipalpi.*" The structure of the adult flies, especially as regards certain details of the venation of the wings, is quite unique but it is in the immature stages of the different genera that the most interesting distinctions are found. The larva, instead of living in the mud along the banks of streams or in rotten wood as do the majority of the known crane-fly larvæ, dwell upon the leaves of various terrestrial and aquatic plants; instead of being brown or grey in color, they are bright green and usually resemble the leaves of their host-plants to a very remarkable degree.

The larva of *Cylindrotoma distinctissima* Meigen lives on the lower surface of the leaves of various plants (*Stellaria* L., *Anemone* (Tourn.) L., *Viola* (Tourn.) L.) and eats elongated holes in them. The larva before undergoing its transformations, leaves its host-plant and crawls to some grass-stalk, where it passes the pupal stage. The larva of *Triogma trisulcata* Schummel, is aquatic, living on the leaves of the submerged moss, *Fontinalis antipyretica* L., in small alpine streams where it was first found in Saeckingen at an altitude of nearly 4000 feet; it spends the winter as a larva, the first specimens being found by Prof. Steinmann at the end of April, fourteen days

* Contribution from the Limnological Laboratory of the Department of Entomology in Cornell University.

after the melting of the snow. The larva of *Phalacrocera replicata* L. has long been known to entomologists as it was first figured by Degeer in 1776. It lives in the water amongst the aquatic plants and mosses; Bengtsson and Mueggenburg believe that it has but one generation in a year, spending the entire winter in the larval state; Miall and Shelford, however, think that it is possible that there are two or more generations of *Phalacrocera* in a single season. The species of the genus *Liogma* O. S. are terrestrial, and live on mosses of the genus *Hypnum* Dill. They will be considered in detail in the remainder of the paper.

The genus *Liogma* was proposed in 1869 by Osten Sacken for the two species known at the time, *Cylindrotoma glabrata* Meigen of the western Palearctic region and *C. nodicornis* Osten Sacken of the eastern Nearctic region. The erection of the genus at this time was merely tentative and neither species was designated as type; it was not until later that the American *nodicornis* was chosen. A third species, *Liogma kuwanai* Alexander, has been described from the eastern Palearctic region but of this form only the adult fly is known.

The larva of the European species, *Liogma glabrata,* was first found by Mr. DeRossi in 1876, but its discoverer was quite at a loss to identify his remarkable insect. In 1878, Osten Sacken, using this short description of DeRossi, pointed out the affinities of this larva with the *Cylindrotomini* and suggested that it was the larva of *Triogma,* then unknown. In 1901, Dr. Mueggenburg's excellent paper on *Liogma glabrata* appeared and the larva and pupa are therein described in great detail. The larva of *glabrata* was found in the woods in the environs of Berlin, in grassy wet spots where the moss, *Hypnum squarrosum* Brch. & Schp., occurs. The following interesting details are taken from Dr. Mueggenburg's paper: the complete metamorphosis of the insect requires one year, of which time but a comparatively short period is occupied by the egg (8 to 10 days) and pupal state (11 to 12 days). The duration of the adult life is not known but it is certainly short and even in the male sex occupies but a few weeks at the

maximum. Near Berlin, the flies emerge during the first half of July. The males appear first, the females later, and these latter were always seized in copulation by the males just after they had forsaken the pupal skin and while still teneral and undeveloped. (In this regard compare also Mik (Entomol. Nachricht, p. 200, pp. 315, 316, 1886); and Caudell (Proc. Ent. Soc. Wash., pp. 45-46, 1913). Each female lays about sixty eggs (like *Phalacrocera*, according to Miall and Shelford) and these are deposited singly on the leaves or branches or attached lightly to the axils of the leaves of *H. squarrosum*. The female dies soon after the accomplishment of oviposition. The larvæ when newly emerged, lack the beautiful moss-green color of the later stages and are ashy-grey. The animal grows very slowly in the autumn, and throughout the winter is still very small and difficult to detect. In the spring the growth is greatly accelerated and the larva becomes fully grown during the latter half of June. While growing, the animal molts several times, probably at least eight, the number determined for *Phalacrocera* by Bengtsson. Pupation occurs in the moss where the larva happens to be. In its green color with brown blotches, the larva simulates remarkably the color of the host-plant and the effect of the shadows cast by various foreign bodies such as plant-stems and leaves. As Mueggenburg says: "so completely does our larva harmonize with its environment that even a practiced eye succeeds only after long inspection in discovering it on the moss branches." The extreme sluggishness of the larva, so characteristic of the American *nodicornis*, is described for this form. Considering our very scanty knowledge of the immature stages of crane-flies, Dr. Mueggenburg's statement that the distribution of the larva is restricted by the distribution of this one moss, *Hypnum squarrosum*, must be taken to be a little too extreme. I have but little doubt but that the larva of *glabrata* will be found on other related species of *Hypnum* when further collections are made.

The American species, *nodicornis*, is of especial interest since it is the genotype. The larva was first observed around Ithaca, N. Y., in the spring of 1913. On May 7, Miss Eudora

F. Tuttle found a large, nearly full-grown larva in moss, *Hypnum cupressiforme* L.* in Cascadilla gorge; the specimen was given to me on the 11th and placed in breeding-jars containing damp moss of the same species. On May 8th, I went to Coy Glen, near Ithaca, and there sifted a dead larva from another species of *Hypnum;* on May 11th I secured another larva from the moss in Cascadilla gorge, and this specimen was likewise transferred to my breeding-jars. On May 25th when these jars were examined, it was found that both specimens had pupated but were still very pale and uncolored. On May 30th, one female emerged from these pupæ and was identified as being this species.

The larvæ of *Liogma* are the most sluggish of any crane-flies known to me. They move only with great slowness and at most times appear to be quite dead. They crawl about amongst the stems of their host-plant and probably never leave it, not even to pupate.

At Orono, Maine, I sifted some *Hypnum* in Standpipe woods on June 16th and found two fully-colored pupæ, which were killed for specimens on June 17th; on the latter date I found a third pupa in the same woods.

In nature the insects probably emerge about the middle or latter part of June and adult flies may be found in June and July. The rapid development and early emergence of these flies in breeding-jars where they are influenced by artificial conditions of heat, light and moisture has been mentioned earlier by Dr. Mueggenburg and others. In our breeding-jars the length of the pupal stage was apparently not more than six days but in the field it is undoubtedly longer.

In the northern part of its range the adult flies probably do not appear before July (Kearner, Ont., July 9, '09; St. Johns, Queb., July 20, '01). In the northern United States the insects are on the wing in late June and early July. (Orono, Me., June 8, '13; Ellsworth, Me., June 15 to July 4, '13; Machias, Me., July 25, '07; Manchester, Vt., June 6, '10; Montpelier, Vt., June 25, '06). In New York state the flies are common in damp

* Determined by Mr. H. D. House and Prof. C. H. Peck of Albany, N. Y.

swampy woods supporting a Canadian fauna and flora. In Fulton county, N. Y., I have taken the form in the gorge of the Cayudutta creek at Johnstown on June 15, '09, which is the earliest date for the county. At Mountain Lake bog-pond both sexes were found in abundance on June 26, '09. At Vandenburg's pond on June 19, 1911, I found the insect in numbers and a living female placed in a vial with a male *Phalacrocera tipulina* was taken in copulation at once and remained "in coitu" for several hours. The last specimens for the year in this county were found at Sacandaga Park on June 27, 1911. As we approach the southern limit of their range they probably emerge in late April or early May. (Hazleton, Pa., June 8, '10; Wooster, Ohio, May 31, '12; Black Mountains, Buncombe county, N. C., May 23, '12). The adult insects are sluggish and do not fly readily and they may be swept from the vegetation that surrounds their haunts. They frequent the rank growth around small shaded ponds where they occur with numerous other crane-flies of the Canadian fauna. At Ithaca, this form is most common in the gorges and on the moist shaded hillsides to which little sunlight penetrates.

I am indebted to the following persons for the data on the geographical distribution of the adult flies: Mr. C. W. Johnson, Mr. M. C. VanDuzee, Miss C. J. Stanwood, Dr. W. G. Dietz, and Mr. J. H. Houser. And to Dr. Needham and Miss Tuttle for kind help in the securing of the immature stages.

This work has been done in the Limnological Laboratory of Cornell University under the direction of Dr. Needham, to whom my thanks are due for kind suggestions concerning many points.

A Key to the Known Larvæ of the Cylindrotomini

1. Body appendages long, filiform; aquatic or nearly so on *Fontinalis antipyretica, Hypnum elodes, H. exannulatum, Ranunculus fluitans,* etc.
   (Palearctic) *Phalacrocera replicata* L.
   Body appendages shorter, leaf-like. 2
2. Dorsal appendages all simple; terrestrial on *Viola biflora* V., *Stellaria nemoralis, Anemone nemorosa,* etc.
   (Palearctic) *Cylindrotoma distinctissima* Meig.
   Some of the dorsal appendages bearing teeth on the anterior convex side. 3

3. Some of the dorsal appendages bearing four teeth on the anterior face; aquatic on *Fontinalis antipyretica.*
(Palearctic) *Triogma trisulcata* Schumm.
The dorsal abdominal appendages with not more than two teeth; terrestrial on Hypnum. 4

4. Most of the dorsal appendages bearing two teeth; on *Hypnum squarrosum.*
(Palearctic) *Liogma glabrata* Meig.
Most of the dorsal appendages bearing a single lateral tooth; on *Hypnum cupressiforme* and a related species.
(Nearctic) *Liogma nodicornis* O. S.

Larvæ of the *Cylindrotomini* may be distinguished from those of other crane-flies by the following easily determined points: color green or greenish; the body provided with filiform or leaf-like appendages; larvæ living upon various Bryophytic or Spermatophytic plants.

A Key to the Known Larvæ and Pupæ of the Genus Liogma Osten Sacken

LARVÆ

1. Prothoracic segment bearing four conspicuous dorsal projections about in a line. Meso- and metathoraces with two pairs of dorsal appendages, each bearing two lateral teeth in front. Second abdominal segment with four dorsal appendages of which the last two bear two teeth in front. *glabrata* Meigen

Prothoracic segment bearing four inconspicuous dorsal tubercles. Meso- and metathoraces with two pairs of dorsal appendages, the anterior pair small, both pairs simple. Second abdominal segment with four dorsal appendages of which the last two bear a single small tooth in front. *nodicornis* Osten Sacken

PUPÆ

1. Pronotal breathing horns directed cephalad and dorsad. Mesonotum bearing two pairs of spines, the more anterior being the smaller, situated just behind the breathing-horns, the posterior pair larger. Metanotum with two pairs of spines. Abdomen with the first tergite bearing two pairs of spines of which the first has two lateral branches, the second simple; the second tergite bears two

pairs of spines of which the first has two lateral branches, the second, one branch; the third tergite bears three pairs of spines of which the first is very short and simple, the second with two lateral branches, the third with one branch; tergites IV and V with three pairs of branches of which the first two are similar to those of the third segment, the last possessing two lateral branches.
glabrata Meigen

Pronotal breathing horns directed cephalad and ventrad. Mesonotum spineless. Metanotum with one pair of spines. Abdominal tergites bearing but a single pair of appendages which are unbranched and correspond in position to the last or more posterior of those of the European species. *nodicornis* Osten Sacken

Detailed Characterization of the Immature Stages of Liogma nodicornis O. S.

larva (Plate I)

Fully grown, length, 14.5-15 mm.; maximum breadth, 3 mm.; maximum depth, 2.5 mm.

Color when living, light green, the numerous spines which cover the body are darker; sides with seven oblique marks, the first of which is on the first abdominal segment, the last on the seventh; the marks on the ends are the smallest and least distinct, the five intermediate marks being large and conspicuous; these marks of one side are all parallel to one another; the caudal face of the ventral lobes which protect the stigmal field, deep black.

Head retracted into the first thoracic segment. Antennæ two-segmented, the basal segment elongate-cylindrical, the tip very short, thimble-shaped, its diameter less than that of the elongate basal segment. Maxillæ with the palpi very short and broad, the basal segment chitinized, the tip narrow, pale; the shape of the maxilla and its palpus is shown in figure 3 of plate I. The mandible works vertically; many-toothed on the inner face at the tip as shown in figure 2 of plate I. The labium has about seven teeth on either side, the ones on either side of the median line being the larger (figure 4 of plate I).

Prothorax, in front, sloping from the anterior end, on the ventral slope provided with the lip-like lobes and the transverse slit through which the head-capsule is exserted. The upper lip is the higher, not strongly chitinized, provided with a few small scattered bristles which are more numerous on the sides of the lobe; lower lip not so high, with small scattered bristles that are not arranged in a row as in *glabrata*. At the angle of the slit is a small rounded lobe bearing a small bristle. Dorsal body appendages reduced to a pair of lobes in front separated by a space a little wider than one of them, and a pair of smaller ones behind very widely separated. Lateral body appendage long, conspicuous. Ventral body appendages not apparent.

Meso- and metathoraces swollen and arched ventrally like the prothorax. Dorsal appendages two, a small conical one in front and a much larger one behind which bears a small tooth in front and with its tip directed backward. Lateral appendages viewed from above, two in number, the anterior one larger, directed sharply backward, the second smaller, conical. Ventral appendages viewed from the side, two, of which the anterior one is the larger, the posterior pair small, slightly behind the others.

Abdominal segments, dorsal appendages: first segment with two pairs of appendages, the anterior shorter, conical, the tip strongly recurved and bearing a tiny tooth on its anterior face at about midlength; the posterior are much longer with the tip bent strongly backward, a small tooth on the anterior face at about one-third the length. Segments II to VII with four pairs of appendages, the first very small, conical; the second exactly similar but larger; the third and fourth similar to those appendages of the first abdominal segment; the tiny first appendage is largest on the second segment, becoming smaller toward the end of the body. Lateral appendages: first segment with three appendages, the first of which is directed laterad, the posterior two more recurved and directed caudad. Segments II to VII with four pairs of lateral appendages of which the first is very small, situated at the antero-lateral angle of the segment, the other three teeth are subequal and directed caudad. Ventral appendages, first segment with three pairs of appendages which

are successively larger, from the short anterior one to the large posterior one. Segments II to VII with five pairs of appendages of which the first three are small, the fourth intermediate between them and the enlarged fifth.

Eighth segment bearing the stigmal field and the caudal appendages. Dorsal side of this field with a pair of long slender lobes which are bent conspicuously cephalad. Stigmal field (figure 5 of plate I) very small, oval, the two rounded-oval stigmata are situated side by side and close to one another, facing one another and capable of being closely appressed. On the ventral side of the stigmal field are two lobes, directed ventrad, which Dr. Mueggenburg regards as being the ninth segment, the inner faces of these lobes with a conspicuous jet-black line, the tip ending in a sharp recurved hook. Ventral surface of the terminal segments with small protuberances.

PUPA (Plate II)

Length from head to the tip of the abdomen, ♂, 10.4-11.4 mm.; ♀, 10-13 mm.

Length from head to tip of tarsi, ♂, 5.2-5.3 mm.; ♀, 5.1-5.4 mm.

Dextro-sinistral width at the wing-pad, ♂, 2-2.2 mm.; ♀, 2.2-2.6 mm.

Dorso-ventral depth at the wing-pad, ♂, 1.9-2.2 mm.; ♀, 2.1-2.5 mm.

Living pupæ have the breathing horns light yellow, the terminal half a little more brownish; a brownish-black mark on the prescutum; the abdomen is greenish, more yellow behind; the dorsal spines are clear light green throughout, occasionally the tips a little infuscated. Alcoholic pupæ—mesonotal prescutum with a dark brownish-black mark, irregularly U-shaped, the arms of the U directed backward, the dark color produced caudad and cephalad along the middle line from this mark; a triangular or rounded black spot on either side of the scutellar lobe; metanotum with a large blackish median blotch which is continued cephalad onto the mesonotal postnotum. Abdomen with an interrupted brownish-black longitudinal line along either side of the middle of the dorsum; the caudal margin

of each tergite suffused with brown. In old and fully colored pupæ, the bases of the dorsal spines are brown, the tips paler; the head and thorax with appendages brown, sometimes very dark; abdomen yellowish.

Male—Bases of the antennæ approximated on either side of the middle line of the venter lying between the cephalic half of the compound eyes; antennæ rather enlarged, directed cephalad, bending around the anterior margin of the eye and thence directed caudad; the antenna ends between the fore tibiæ and femora just beyond the joint, the tip about on a level with the lobes of the labium; in older pupæ the peculiar nodose segments of the imago show through the sheath. Eyes rather large; labrum elongate, slender. Cephalic portion of the head very flat and broad without spines; a small blunt tubercle between the antennal bases.

Pronotal breathing horns large, conspicuous, directed dorsad and laterad, the apical half bent rather suddenly cephalad. Mesonotum feebly wrinkled. Metanotum with two long slender spines arising beyond midlength of the segment, directed caudad and scarcely dorsad, their tips parallel or slightly convergent. The fore femur is long, ending on a level with the caudal portion of the eye; the fore tarsi are shortest, the hind tarsi longest, this relation holding for all the tarsal segments throughout; the tip of the hind legs is just before the caudal margin of the third abdominal segment. Wings broad, reaching the caudal margin of the second abdominal segment.

Abdomen, viewed from above, with the first segment about one-half as long as the second; segments II to VII subequal in length. Tergites I to VII bear a long slender spinous projection from either side of the median line, shortest on the anterior segments, longest on the seventh segment. These projections arise from near the caudal margin, those on the anterior segments more parallel, those on the rear segments becoming divergent; these projections are directed caudad and dorsad, those behind being almost perpendicular to the body. Segments II to VII have the lateral margins produced into three sharp spines, these spines being near the base, middle and caudal portion of

each segment. These spines are directed laterad and caudad, the terminal spine more sharply caudad than the other two. Sternites—Segment III with a small subapical spine on either side, these being very widely separated, about midway between the median line and the lateral margin of the segment; segment IV with the same spines but larger and more prominent; segments V to VII similar but with another pair of small spines about midlength of the segment and much nearer to the middle line of the body. Segments II to VII with a subbasal triangular pit or mark, widely separated. Eighth tergite with the caudal margin rounded, concave, the lateral angles produced backward, upward and slightly outward as strong spines; suture on the ventral surface incomplete; two small spines on either side of the middle line of the body. Ninth tergite produced caudad as two strong, parallel, spinous projections. Hypopygium from beneath, the lower valve very long, about concealing the dorsal valve, at its tip with four small spines directed outward and caudad, these spines on the caudo-lateral angle of the segment. (See figure 1 of plate II).

Female—Very similar to the male, the antennal sheaths smaller and not so closely approximated basally; the lower valve of the ninth segment slender, obtuse at apex, feebly notched; upper valves broader, longer, with a deep median split, the lobes rounded. (See figures 3 and 4 of plate II).

Larva described from one specimen taken in Coy Glen, Ithaca, N. Y., May 8, 1913.

Pupæ described from two females; Cascadilla creek, Ithaca, N, Y., killed on May 30, 1913. (One taken as a fully-grown larva, May 7, 1913, by Miss Eudora F. Tuttle; the other taken by the author as a larva on May 11).

Two pupæ from Orono, Maine, killed on June 17, 1913, and a third fully-colored specimen from the same place on June 19.

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EXPLANATION OF THE PLATES

PLATE I. THE LARVA.

Figure 1. Dorsal aspect of the larva.
Figure 2. Mandible, lateral aspect.
Figure 3. Mandible, ventral aspect. *a*, mandible; *b*, antenna.
Figure 4. Mouthparts, ventral aspect. *a*, maxillary palpus; *b*, stipes; *c*, cardo; *d*, labium.
Figure 5. Caudal end of the larva, caudal aspect, looking into the stigmal field.
Figure 6. Lateral aspect of the larva.

PLATE II. THE PUPA.

Figure 1. Lateral aspect of the pupa; male.
Figure 2. Dorsal aspect of the pupa; male.
Figure 3. Dorsal aspect of the end of the abdomen; female.
Figure 4. Ventral aspect of the end of the abdomen; female.

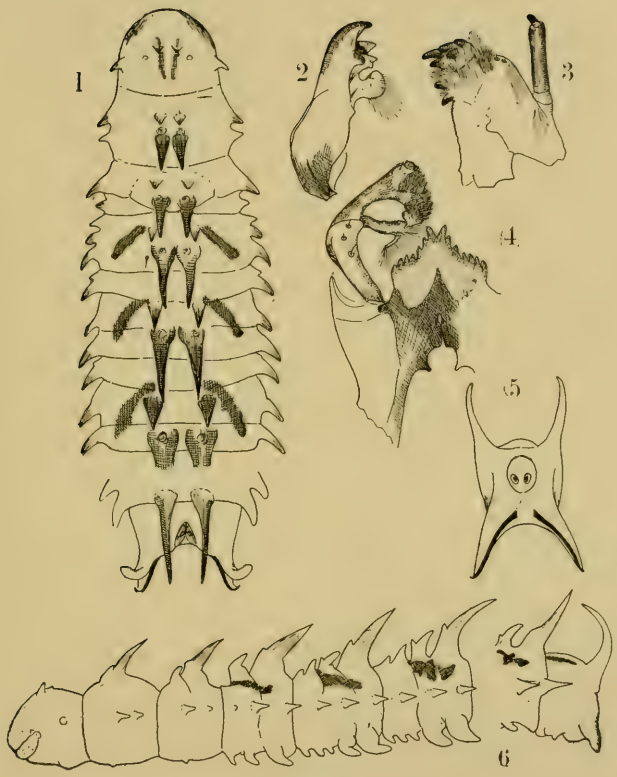


PLATE I

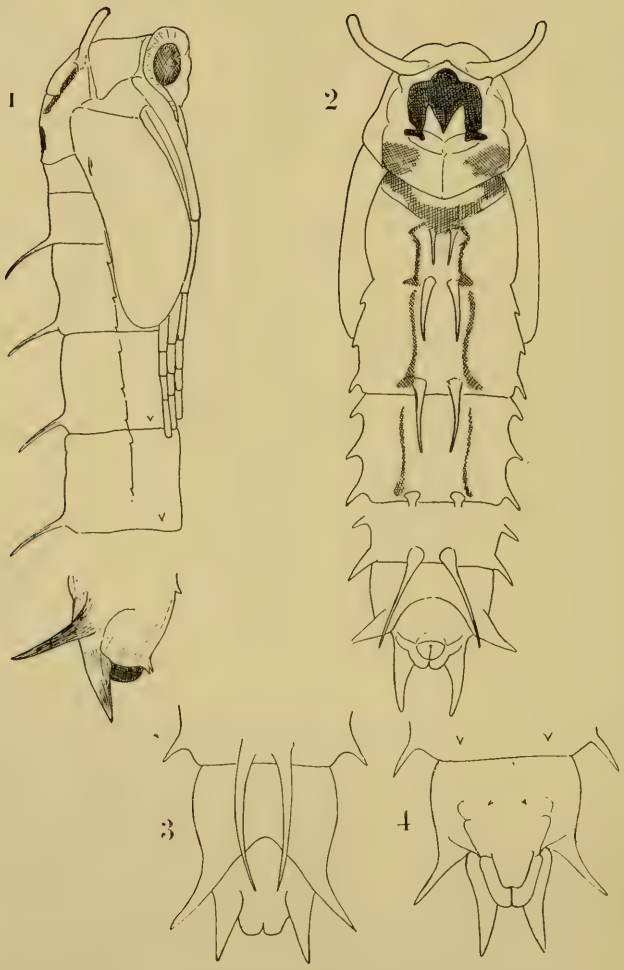


PLATE II

The Geographical Distribution of Our Common Red Spider, Tetranychus Telarius Linn

H. E. EWING
CORVALLIS, OREGON

Introduction

Our common red spider, *Tetranychus telarius* Linn., is apparently an introduced pest. In Europe it has been known to science for over a century and a half, where it not only is found on many cultivated plants, but also is found on many wild, or native ones. Hence it is very probable that Europe is the native home of this alien mite.

Just when this pest was first introduced into this country we do not know, but probably at a very early date on greenhouse plants. In 1855 Glover reported a red spider from cotton which was doing considerable injury. The species was very probably no other than the cotton red spider of today, which we should regard as *T. telarius* Linn. In 1869 Shimer made reference to a red spider, but probably he was considering a different species. Saunders in 1880 refers to this species, but does not give us an extensive account of it.

In working out the distribution of this mite pest in the United States, I have not only consulted the literature relative to the red spiders, but I have also written many letters to entomologists, and specialists in the Acarina, have collected specimens in some dozen different states, and have examined slides in several educational institutions. I am especially under obligations to Prof. H. J. Quayle of the University of California for many specimens from the citrus regions, and to Dr. Nathan Banks for the privilege of examining some of his specimens of red spiders, and for getting the many records which he has obtained of the occurrence of the species in this country.

Distribution Over the World

The common red spider is nearly world wide in its distribution. In Europe, where it has been known the longest, it is a serious pest in the following countries: England, France, Germany, and Italy. It probably is generally distributed in this continent except in the northern part of Russia and in the Scandinavian Peninsula.

In North America the species is found from Ontario to Texas in the eastern part of the continent, and from British Columbia to Southern California along the Pacific Slope. It is also widely distributed in the interior of the United States.

The species is known from South America, Hawaii, and South Africa, and is a serious pest in Australia.

We have questionable records of the species from the West Indies and Mexico; while it is very probably present in western Asia and northern Africa. I have failed to find any record of the mite occurring in India, or in the Philippines.

Distribution in the United States

The distribution of the common red spider in this country is here given in the form of a map (see Fig. 1). Not only are the authentic and questionable locality records given, but also the regions where there is a known general distribution of the mite, or those where there is probably a general distribution of the same.

By examining this map we notice that there are seventy-seven authentic locality records of the species in the United States; and in addition there are eleven questionable ones. It is also noted that we have authentic records of this species occurring in thirty-one different states, and in the District of Columbia. We also have an unauthentic record of the species occurring in one other state.

Regions of Known General Distribution

These regions are six. They are here given: (*a*) The New England states plus New York State; (*b*) the southeastern part

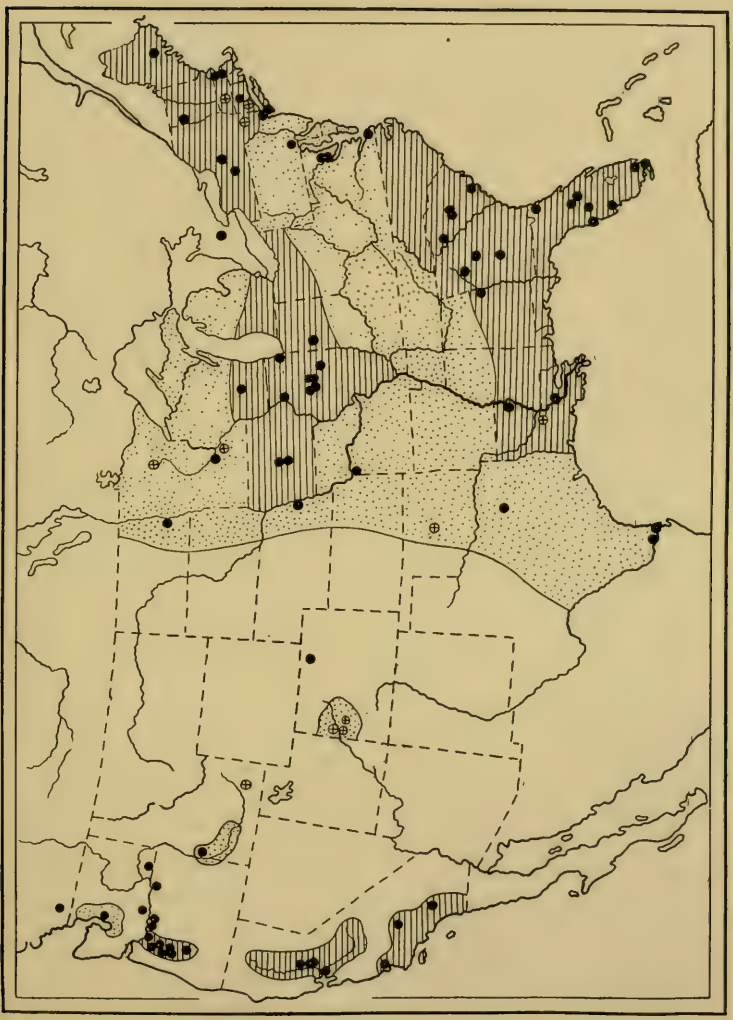


FIG. I

of the cotton belt, including the states of North Carolina, South Carolina, Georgia, Florida, and Louisiana, and the southern parts of Mississippi and Alabama; (*c*) a large area in the region of the north central states including the states of Iowa and Illinois, the southern parts of Wisconsin and Michigan, and the northern parts of Ohio and Indiana; (*d*) the Willamette Valley in Oregon; (*e*) the interior regions of California, including the valley of the Sacramento and San Joaquin rivers; (*f*) the southern California citrus region. That the common spider mite is generally distributed in these regions is shown, not only by the authentic reports of its occurrence in them but also by the statements of specialists in the Acarina as to its general distribution. That the species is generally distributed in the New England states and New York State is shown by the work of Harvey, by the statements of L. H. Bailey and others. Besides this the writer has had much personal experience with the red spider in New York State. The general distribution of the pest in the southeastern part of the cotton belt is established by the statements of Morgan and McGregor. Morgan stated in his bulletin on this pest from the Louisiana Experiment Station that the red spider was common in any part of the state of Louisiana; while McGregor gives us many records of its injury in the cotton belt, but states that it was only from the southeastern portion of the same that complaints of an alarming nature were received. Mr. E. S. G. Titus states that the red spider has been found in several localities in North Carolina. In the north central states we have many reports of the species in Illinois given by Professor S. A. Forbes and his assistants. The writer himself has by personal examination found the species in many parts of Illinois and Iowa. I have also observed it in southern Wisconsin and in Ohio. In the Willamette Valley of western Oregon the writer has made many records of the species, and has been repeatedly told of its presence and injury by others. The general occurrence of the red spider in the interior of California is shown by the recent work on this pest by Parker. Quayle states that the common species of red spider is distributed in southern California on ornamental shrubs and vegetables.

Regions of Probable General Distribution

Besides the regions mentioned where the common red spider is known to be generally distributed, there are others equally extensive where it is probably generally found, yet up to the present we have no authentic record to show that it is found generally distributed over these parts. It is very probable that at present this red spider is generally distributed over the eastern half of the United States, *i. e.,* as far west as the dry plains of western Dakotas, Nebraska, Kansas, Oklahoma, and Texas; besides this vast area there are at least three small, more or less local, regions in the far west where the pest is probably generally found. These are: (*a*) the Puget Sound region in Washington State; (*b*) the Snake Valley region of southwestern Idaho; and (*c*) western Colorado.

That the species is generally distributed over the eastern half of the United States is indicated by the following facts:

1. It has been recorded from Orono, Maine, and also from Brownsville, Texas, thus showing that there is nothing in the extremes of temperature due to climate that would prevent it occurring throughout this area.
2. There are no altitudes so great in this region that the species could not thrive.
3. Some of its common host plants are found in any part of this area.
4. It has been long enough introduced into these sections to have become generally distributed.
5. It has been reported from several different localities in this region of probable general distribution.

Although we have but a single record of *T. telarius* occurring in the Puget Sound region, the writer is of the opinion that the species is generally distributed here because the climate and types of agriculture are very similar to those of the Willamette Valley in Oregon, where I find the species in great abundance.

In southwestern Idaho we have an authentic and a questionable record. This area is given over very much to the raising of fruit and other favorable hosts of the mites. The climate is

dry, and during the summer is hot. The species has been present here for at least fourteen years, and has consequently had much time in which to be disseminated. For these reasons we should expect to find the mite quite generally distributed over this section.

Weldon ('09) gives several records of a species of red spider, which he called *T. bimaculatus* Harvey, in western Colorado. Here this species has been reported as doing very serious injury to orchards. I have received several specimens of these mites supposed to be the common spider mite, but found that they were of a new species. This species was described as *T. weldoni* Ewing. Yet notwithstanding this fact, since reading again Weldon's bulletin, I am of the opinion that the common red spider was present also, and generally distributed in western Colorado.

Notes on Questionable Records

The questionable records given in the tabular data concerning the distribution of this species in the United States, and represented by a circle with cross in the map, are of four kinds.

a. Records which probably refer to *Tetranychus weldoni* Ewing.

b. Records which probably refer to *Tetranychus flavus* Ewing.

c. Those where no specific determinations were made, but which probably refer to *Tetranychus telarius* Linn.

d. Memory records.

The questionable records given for western Colorado probably refer to *Tetranychus weldoni* Ewing. These were reported under the name of *Tetranychus bimaculatus* Harvey.

The questionable record from North Dakota refers to a species of spider mite that caused serious damage to spruce trees in 1912, according to Professor C. B. Waldron, of the North Dakota Agricultural College. In this instance no specific determination was made.

The record for Oklahoma refers to a species of red spider that was doing serious damage to a field of wheat at Wheatland, near Oklahoma City; no specific determination was made.

The record for southeastern Idaho refers to a species which I found in some abundance around Pocatello in the summer of 1911. If it was not our common species, it very probably was *T. flavus* Ewing, which is so common in some sections of eastern Oregon.

Regions Found to Be Free from General Infestation

Although we have five authentic records of the common spider mite occurring along the Columbia river east of the Cascade mountains, yet it is not generally distributed in this section. I have made many trips to this part of the state and find that the species is not generally distributed here.

The common red spider apparently is not found in the Coast Range mountains or in the forest reserves along the Cascades in the state of Oregon, and the same is probably true of most of the other national forests.

The great plains regions between the Rocky mountains and the eastern parts of the Dakotas, Nebraska, Kansas, Oklahoma, and Texas, are probably free from general infestation. These regions are largely occupied either by native grasses or by field crops that are not commonly host plants of the red spider. I find that our native plants are remarkably free from attacks of the introduced red spider, hence it is probable that the native plants in this vast stretch of land are free from attack at the present time. Professor Waldron writes that the only places where the red spider has been found in North Dakota are upon plants that have been introduced. Hence in that state it does not appear to be generally distributed.

Factors Affecting Geographical Distribution

The chief factors affecting the distribution of *T. telarius* Linn. are those of climate and of host plants. Wherever the mean daily temperature falls below about 50 degrees Fahrenheit this mite will not reproduce, but will hibernate, under advantageous conditions. Unless there is a summer mean considerably above 50 degrees Fahrenheit we would not expect this species to be present. Red spiders have been reported at elevations of from

7000 to 8000 feet, but I have never found *T. telarius* Linn. above an elevation of about 1500 feet, yet I see no reason why it should not be found above this elevation.

Under out-of-door conditions we do not have temperatures so high as to check this species. It is claimed that in the hottest part of the summer in southern California the spider mite does not thrive as well as where the temperature is not so great.

This species does not thrive as well in a wet climate as in a dry one. Yet neither an excessively wet nor an excessively dry climate will prohibit its development.

The presence or absence of favorite host plants has much to do with the distribution of the spider mite. The absence of an acceptable host precludes its existence in any region.

Lastly, this pest being one especially fond of greenhouse plants, may be found wherever plants are grown under glass with the aid of artificial heat. Doubtless it is found in many places under these artificial greenhouse conditions where it could not persist out of doors.

A Tabulation of the Localities in the United States Where the Common Red Spider Has Been Reported, Together With the Authority, the Host Plant or Plants, and Notes on the Nature of the Injury

These records are grouped alphabetically according to states, and according to the records in each state. An asterisk is placed after questionable records.

Locality Record	Authority	Host Plant	Nature of Injury
Auburn, Ala.	F. H. Chittenden	Cowpeas, beans	
Alabama (Several localities)	E. S. G. Titus		
Lindsay, Cal.	Bureau of Entom.		
Oakley, Cal.	Bureau of Entom.		
Perkins, Cal.	W. B. Parker	Hops	Slight
Redlands, Cal.	Bureau of Entom.		
Sacramento, Cal.	W. B. Parker	Hops	Considerable
Sacramento Valley, Cal.	W. B. Parker	Hops Morning glory	Serious
San Luis Obispo,Cal.	Bureau of Entom.		
Wheatland, Cal.	W. H. Volck W. B. Parker	Hops	Serious
California (north central part)	H. J. Quayle	Hops	
California (Southern)	H. J. Quayle	Citrus trees, violets, beans, ornamental shrubs	
*Delta, Colo.	G. P. Weldon	Roses	
Fort Collins, Colo.	N. Banks	Maple	
*Grand Junction, Colo.	G. P. Weldon	Plum trees, peaches	Causing yellow patches on leaves of peaches
*Palisades, Colo.	G. P. Weldon	Peach trees	
*Colorado (Generally distributed over western part)	G. P. Weldon		
*Ansonia, Conn.	W. E. Britton	Spinach	
New Haven, Conn.	W. E. Britton	Violet, ash tree	Bad infestation on ash. Leaves turned yellow and dropped
Washington, D. C.	N. Banks	Violets, *Datura*, squash, peaches, corn, strawberry	
Eustis, Fla.	F. H. Chittenden	Watermelon	
Galloway, Fla.	F. H. Chittenden	Strawberry	Generally destructive
Keylargo, Fla.	F. H. Chittenden	Eggplant	
Miami, Fla.	Bureau of Entom.		
Orlando, Fla.	F. H. Chittenden	Wax beans	Considerable
Punta Gorda, Fla.	F. H. Chittenden	Eggplant	
St. Nicholas, Fla.	W. H. Ashmead	Castor bean tree	Webs covered every leaf. Leaves dry, yellow, blotched
St. Petersburg, Fla.	Bureau of Entom.		

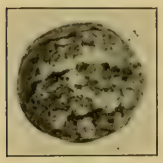
Locality Record	Authority	Host Plant	Nature of Injury
Florida (General infestation)	H. M. Russell	Truck crops, general crops, citrus trees, wax beans	Injury very noticeable
Florida	N. Banks	*Datura*	
Atlanta, Ga.	E. L. Worsham	Violets	Serious
Monticello, Ga.	Bureau of Entom.		
Unadilla, Ga.	E. L. Worsham	Beans, tomatoes, blackberries, golden rod	Considerable
Georgia (widely separated sections)	E. L. Worsham	Cotton	Serious
Georgia (Several points)	E. S. G. Titus	Cotton	Serious
*Pocatello, Ida.	H. E. Ewing	On various plants	Considerable infestation
Weiser, Ida.	F. H. Chittenden	Roses	
Bloomington, Ill.	F. H. Chittenden	Raspberry	
Chicago, Ill.	J. J. Davis H. E. Ewing	Elm	Leaves become yellow and sickly, and fall prematurely
Morrison, Ill.	Bureau of Entom.		
Normal, Ill.	S. A. Forbes	Larch	Foliage seriously affected. Trees looked as if they would die
Pekin, Ill.	Forbes & Hart	Sugar beet, hemp	Not serious. Leaves discolored; lower surface covered with dirty web
Fremont, Ill.	Forbes & Hart	Sugar beet, hemp	
Urbana, Ill.	H. E. Ewing	Several plants	Moderate injury
Illinois	S. A. Forbes	Maize, sugar beet	Seldom causing serious injury
Lafayette, Ind.	Bureau of Entom.		
Ames, Ia.	H. E. Ewing	Apple leaves, potato plant, tomatoes, chrysanthemums, evergreens	
Des Moines, Ia.	H. E. Ewing	Alfalfa	
Iowa (Several localities)	H. E. Ewing		
Baton Rouge, La.	H. A. Morgan	Cotton, citrus trifoliata	Serious injury
*Mansura, La.	V. I. Safro	Cotton	
Tallulah, La.	V. I. Safro	Cotton	
Louisiana	H. A. Morgan	Cotton	
Orono, Me.	F. L. Harvey	Pepino, clematis, beans, roses, cucumbers, verbenas, tomatoes, and various other plants	
Berwyn, Md.	Bureau of Entom.		
*Amherst, Mass.	C. H. Fernald	Roses	Bad infestation
Forest Hills, Mass.	Bureau of Entom.		
Melrose Highlands, Mass.	N. Banks	Ash	

Locality Record	Authority	Host Plant	Nature of Injury
Michigan	G. C. Davis	Celery	Causes little blotches quite thickly over the under side of leaves
*Cannon Falls, Minn.	F. L. Washburn	House roses	
*Deer River, Minn.	C. W. Howard	Oak tree	
Minneapolis, Minn.	C. W. Howard	Entering house	
Kansas City, Mo.	Bureau of Entom.		
Omaha, Neb.	Bureau of Entom.		
Nevada (Western part)	F. H. Hillman	Fruit trees, currants, and elms	Causes browning of leaves
Brooklyn, N. Y.	Bureau of Entom.		
Ithaca, N. Y.	L. H. Bailey	Beans, Indian mallow, apricot, godelia, morning glory, several other plants	
*Milton, N. Y.	P. J. Parrott W. J. Schoene	Raspberries	Injury to leaves
New York City, N.Y.	F. H. Chittenden	Greenhouse plants	
Waterville, N. Y.	N. Banks	Hops	
North Carolina (Several places)	E. S. G. Titus	Cotton	Severe
Fargo, N. D.	C. B. Waldron	In greenhouse	Slight infestation
Wheatland, Okla.	A. L. Lovett	Wheat	Severe injury to a few acres
Albany, Ore.	H. E. Ewing	English walnut	No injury noticed
Corvallis, Ore.	H. E. Ewing	Strawberry, apple, cherry, currant, roses, cucumber, many other plants	Injuries frequently serious
The Dalles, Ore.	H. E. Ewing	Blackberry, cherry, peach	
Eugene, Ore.	H. E. Ewing	Roses, cherry, pear	Moderate infestation
Hermiston, Ore.	H. E. Ewing	Strawberries	Badly infested
Hood River, Ore.	H. E. Ewing	Apple, cherry, red alder, willow, lettuce, rose, several other plants	Found in one greenhouse chiefly
Independence, Ore.	H. E. Ewing	Hops	Very serious
McMinnville, Ore.	H. E. Ewing	Violets, rose, red clover, white clover	Serious to violets
Portland, Ore.	H. E. Ewing	Large-leaved maple, roses	Infestation slight
Salem, Ore.	H. E. Ewing Bureau of Entom.	English walnut, beans, peaches, hops	Moderate injury
Westgrove, Pa.	F. H. Chittenden	Greenhouse plants, roses	
Batesburg, S. C.	E. A. McGregor	Cotton, *Datura*, blackberries, violets, chenopodium botrys Thea japonica L.	Very serious
Charleston, S. C.	F. H. Chittenden	Snap beans	Hosts totally destroyed
Dean, S. C.	Bureau of Entom.		
Leesville, S. C.	E. A. McGregor	Cotton	Severe
South Carolina (several localities)	E. S. G. Titus	Cotton	Severe

Locality Record	Authority	Host Plant	Nature of Injury
Brownsville, Tex.	F. H. Chittenden		
Dallas, Tex.	V. I. Safro		
Santa Maria, Tex.	Bureau of Entom.		
Tanner's Creek, Va.	Bureau of Entom.		
Burlington, Vt.	G. H. Perkins	Rose	
Vermont (Common)	G. H. Perkins	On many plants	Serious injury
Brighton, Wash.	F. H. Chittenden		
Goldendale, Wash.	C. A. Barnes	Strawberries	Causing very serious injury. Leaves turned red and cupped
Walla Walla, Wash.	Bureau of Entom.		
Washington State	W. B. Parker	Hops	Slight
Portage, Wis.	H. E. Ewing	Cucumber vine	Causing some injury
Wisconsin	E. S. Goff	American plums	Injures foliage, making leaves look unhealthy

The Eleventh Kermes (Coccidæ) From California

GEO. B. KING
LAWRENCE, MASS.



Kermes mirabilis n. sp.

Female scale—Subglobular, color gray, surface dull, not shiny. Diameter 7 mm. Markings consist of five transverse black bands, composed of quite large round dots and fine lines. Between the lines and dots the surface is pebbled and marbled with black dots and specks. The entire surface is covered with minute black specks. There are also some very faint reddish-brown patches.

Habitat—Mountain View, California. Sent to me as *Kermes galliformis* by Mr. E. M. Ehrhorn in 1901.

Host—Oak, *Quercus* sp.

Relations—Allied to such species as *Kermes galliformis,* etc.

The Central Nervous System of the Pycnogonid *Lecythorhynchus*

WILLIAM A. HILTON

During the summer of 1914 the pycnogonid *Lecythorhynchus marginatus* Cole was found abundantly at Laguna Beach and the results of a general study of the central nervous system are given at this time.

The small size of the animals made sectioning methods necessary from the start. Because of the hard exoskeleton, great difficulty was experienced in preparing slides, and a number of specimens were cut before complete series were obtained. Nothing in the fixation seemed to greatly help, but certain individuals seemed to have softer cuticle.

There are six chief ganglia forming the central nervous system of the adult. The more cephalic centers are a little smaller than the others.

Five ganglia are described by Dohrn '81 and others, due no doubt to a more definite fusion of certain centers. In the embryo of *Palene,* as described by Morgan '91, there are ganglia corresponding to each of the pairs of appendages, those of the seventh or last pair and the abdominal ganglia appear last in development.

Merton '07 describes six pairs of ganglia in *Nymphon parasiticum,* the second pair, or the first subesophageal center, is clearly shown to be composed of two parts on each side, but the last pair represents the abdominal ganglia, if one may judge from the figure given.

In *L. marginatus* the first three cephalic ganglia are quite close to each other and partly fused, as the figure shows. The last three ganglia are more widely separated. From one to two abdominal ganglia are described in other pycnogonids. In this species the abdomen is very small and no ganglia were found. Probably all of the abdominal elements are fused with the last thoracic ganglion.

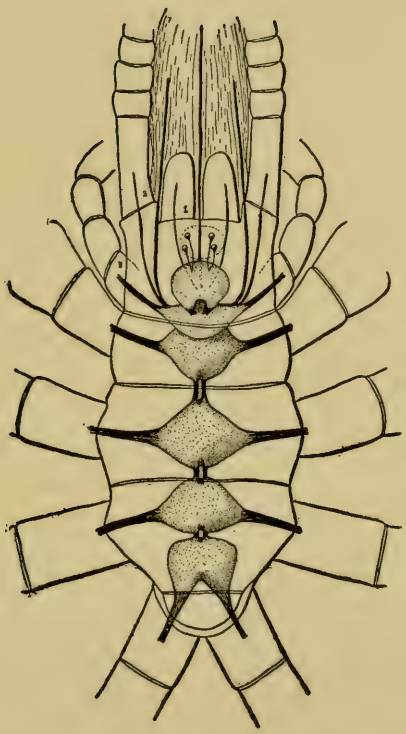


Diagram of the position of the nervous system of *Lecythorhynchus marginatus*, compiled from longitudinal and cross sections. Slightly diagramatic. X50. 1, 2 and 3, first, second and third appendages.

The supraesophageal ganglion is of rather small size. It sends small nerves to the eyes, to the first pair of appendages or chelifori and a mid-ventral branch to the proboscis.

The subesophageal ganglion supplies the other cephalic appendages. There are three branches from each side of this ganglion, one pair is for the proboscis, one for the palpi, or second appendages, and one pair for the ovigers, or third appendages. The second and third appendages are spoken of by some authors as being supplied by distinct ganglia. In this species there is no division into two centers.

The chief branches of all of the other ganglia are to the four larger appendages, or walking legs.

IMPORTANT LITERATURE

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(Contribution from the Zoological Laboratory of Pomona College.)

The Distribution of Collembola in the Claremont-Laguna Region of California

GERTRUDE AULD BACON

GENERAL HABITS

The Collembola, although minute in size, are very common, being found in almost every condition where there is moisture and some decaying vegetable matter. Moisture seems to be essential to their existence. They are common under rocks, bark of trees, under leaves, in rotten logs, and in moss. Some species collect in great numbers on the surface of standing water, and others, the snow-fleas, appear in crowds so dense as to cover the snow. Some have been found in houses, in ant nests and in the gills of mushrooms. Some species, as *Entomobrya laguna,* are found only on the undersides of rocks in the ocean. They do not generally penetrate deeply into the soil, usually being found on the surface and seldom deeper than three inches. The soil must be of a loose, open texture. They seem to avoid the light and are timid and retiring. Very few of them are solitary and several species may be found together. The complex forms are very lively in their movements and are hard to catch but the simple forms that lack the spring are more sluggish. Some species require more moisture than others and so appear at different times, but most of the species may be found the year around providing there is plenty of moisture.

There is very little exact knowledge about the food of the Collembola, but an examination of the stomach contents seems to show that they feed upon decaying vegetable matter. Very little has been written on the feeding habits. Dr. Fitch observed that the front legs were often used to crowd the food into the mouth. Folsom (1899) states that possibly the food is moistened with saliva before being eaten and then the food

is pulled into the mouth by the retraction of the mandibles assisted by the upper and lower lips, the coarse food being crushed by the ventral teeth of the mandibles.

Except in the canyons, the best collecting time in Southern California is in the winter, due to the absence of rain in the summer. The Collembola do not exist here in as great abundance as reported from other places, because of the dry climate. The only ones I have found in any great number were a species of *Achorutes* found in a flume in an orange orchard after a hard rain. They were several inches deep in this flume and would have filled several gallon pails. Also all the rotten oranges in the orchards were blue with this species. They were also found in great numbers on pools in a newly ploughed field after a hard rain.

ECONOMIC IMPORTANCE

Until recently, the Collembola were not considered of much economic importance and very little attention was given to them, due no doubt to their minute size and their seeming insignificance. Most authorities considered that they were followers of decay rather than the primary causes of it, that their jaws were too weak to enable them to masticate a root or leaf and that they didn't attack a plant until some other insect had first inflicted an injury. During the last few years, however, this problem has been investigated and it has been found that the Collembola do cause injury to plants, and often serious injury. References in the literature are very few, but among the earlier ones we find that Mr. Curtis in his work on farm insects says, "In Nova Scotia the crops of turnips and cabbages are principally destroyed whilst in the seed-leaf by some *Smynthurus,* the size of a pin's head and nearly globular. It hops with great facility and may be found on every square inch of old cultivated land, but it is not plentiful on new land."

Dr. Asa Fitch says, "Our gardeners universally regard these fleas as being injurious but not so severely injurious as the larger-sized flea-beetles, with which they are almost always

associated." He investigated this subject and came to the conclusion that the Collembola never attack a perfectly green and healthy plant. Of the species *Smynthurus arvalis,* Fitch says, "It is common to see them in the garden, upon the leaves, particularly of the pie rhubarb, where these leaves are perforated with holes by the flea beetles." Guthrie states that he had never met with any gardeners of the State of Minnesota who had noticed any damage from these insects and he himself had ever seen them feeding upon green plants. Guthrie also states that he learned from Prof. H. E. Summers, State Entomologist of Iowa, that a certain species of *Achorutes* kept the soil so stirred up that the young plants couldn't take root and many of them died. Collinge mentions a similar case that came under his notice in which a bed of sweet peas was destroyed.

During the last few years the men who have worked the most on this subject were Carpenter, Evans, Theobald and Collinge of England and Scotland. Carpenter has recorded *Achorutes longispinus* Tullb. and *Lipura ambulans* Linn. as causing injury to bean seeds. Theobald speaks of certain Collembola attacking orchids and others damaging hops. Also he records a species of *Isotoma* which tormented fowls. Marlatt describes a species of *Lepidocyrtus* which infested the houses in Washington, D. C. Collinge has carried on some very careful observations which have established without a doubt that Collembola are distinctly injurious to orchids, beans, peas and numerous bulbs of which the hyacinth, narcissus and tulip suffered the worst. In speaking of the nature of the injury he says, "It is practically the same in all cases, and consists in scraping away the epidermis and then the softer tissue until a distinct hole or depression is formed. After this stage, decomposition of the plant tissues rapidly takes place, due to the inroads of fungi and the bulb is practically ruined."

Collinge also records an instance where the Collembola have damaged pine trees. The opening buds of some shoots of *Pinus sylvestris* were found to be falling off and the young needles had a dry, withered appearance and many of them fell

off when handled. It was found on examination that in the damaged buds there were several Collembola of the species *Seira nigromaculata* Lubb. He found that the insect was attracted by the resinous gum and as soon as the bud opened it made its way to the base of the young leaves and commenced to bite them.

I had some specimens of *Aphorura inermis* sent to me which were found inflicting damage to tender roots of young plants near Santa Barbara. This is the only instance of injury that has come to my notice here in California. In all the orange groves in and around Claremont this year (1914) the rotten oranges were covered with Collembola of the genus *Achorutes* but in no case were they found attacking the good fruit.

DISTRIBUTION

Insects are among the most widely distributed of the animal groups and the Collembola are among the most widely distributed of these. This is due to the fact that they are not specialized in regard to their food, feeding on small particles of organic matter; that moisture is important to their existence; that they are tolerant of extremes in temperature; and that these simple conditions can be found almost anywhere.

The region in which I have been working is about forty miles wide and sixty miles long, extending from the Sierra Madre Mountains on the north to the ocean on the south. This region is varied and a most favorable one, containing, as it does, mountains, canyons, hills, valleys, swamps, and ranging in altitude from sea level to 10,000 feet. I, therefore, had a wide range of conditions from which to study the Collembola and as is to be expected, found many differences (figures 1 and 2).

Folsom (1901) has written an article on the distribution of Holarctic Collembola, the only contribution on this subject. In it he states that no less than one hundred and fifty-two species of Collembola are known to occur in North America, of which thirty at least are shared with Europe. Since then this number has been increased. Of those seven that Folsom lists as occurring abundantly throughout Europe and the United States, I

found *Isotoma viridis, Isotoma palustris, Aphorura inermis,* and *Entomobrya multifasciata.* Another species that I found here that is widely distributed is *Isotoma besselsii,* having been reported from Polaris Bay, Spitzbergen, Massachusetts

Figure 2. Position of the Claremont-Laguna region in California.

Bay, and Cold Spring Harbor. *Neanura gigantea,* which has not been found except in Siberia, Alaska, and Yenisei River, were found here in considerable numbers. I am pleased to be able to report *Pseudosira domestica* from this region, as it has only been recorded from England and as very rare. *Sinella curviseta* has not been found in any other place in the United

States and we share it with England. I also found two new species of *Tullbergia* here and two of *Drepanura,* and it is the first time these genera have been recorded from the United States.

In regard to local distribution, the forms found most widely were *Isotoma viridis, Entomobrya multifasciata, Neanura gigantea, Entomobrya binoculata* and a new species of *Isotoma.* These all were very abundant and found in nearly all the localities from which Dr. Hilton or I have collected.

There was not a marked difference between the Collembola found in the different canyons. San Dimas and Palmer's canyons had the greatest number of different forms, due no doubt to the great abundance of vegetation in those canyons. The *Drepanura* were confined entirely to the high altitudes, being found only on the slopes of Mt. San Antonio at 6000 and 7000 feet. Three species of *Aphorura, Isotoma palustris, Tomocerus vulgaris* and *Entomobrya* were also found only in the mountains.

The two species of *Tullbergia* were the only forms found exclusively in the hills. The forms found entirely in the valley were *Cyphodeirus albinus, Sinella curviseta, Entomobrya clitellaria, Isotoma minima,* and a member of the genus *Achorutes.*

The forms that were peculiar to Laguna Beach were *Isotoma besselsii, Isotoma bidenticula,* and *Entomobrya laguna.* These were found as far out in the ocean as one was able to turn over the rocks at low tide. This is the first time that the genus Entomobrya has been reported from under rocks in salt water.

With the exception of Schött, who has described some thirty species, mostly from the northern part of the state, no work has been done in California. This region around Claremont has not been touched at all and as is to be expected several species were found that had never been described before. Many interesting points were also gained on the subject of distribution. As yet I have by no means exhausted the field and I hope some time to be able to continue the study of this region.

KEY TO THE FAMILIES, GENERA AND SPECIES OF *COLLEMBOLA*

KEY TO THE ORDER COLLEMBOLA

A. Furcula present.
  B. Furcula attached on the penultimate segment.
    C. Abdomen globular, little longer than broad; segments fused together; scales never present; claws two; antennæ four-jointed; no post-antennal organ. Family SMYNTHURIDÆ
    CC. Abdomen sub-cylindrical, longer than broad, segments free; scales present or absent; claws two. Family ENTOMOBRYIDÆ
  BB. Furcula attached to antepenultimate abdominal segment. Body sub-cylindrical, segments free; antennæ four-jointed; claws two or one. Family PODURIDÆ

AA. Furcula wanting. Family APHORURIDÆ

Family SMYNTHURIDÆ

There is little danger of confusing the members of this family with those of any of the other families for the globular abdomen and its fused condition easily distinguishes it. The head is carried in a vertical position, the ventral tube is long and well developed, ocelli sixteen. The majority of this group are beautifully marked.

I found fewer specimens of this family than of any of the others and in fact I hunted for a year and a half before I found any at all and then only a few specimens which have not yet been determined.

KEY TO THE FAMILY SMYNTRURIDÆ

A. Antenna IV shorter than antenna III. The distal part of antenna III ringed. Genus *Papirius*
  B. Antenna IV longer than antenna III. Antenna III not ringed. Genus *Smynthurus*

Genus *Papirius* Lubb.

I found one member of the genus near Escondido in leaves under a sumach bush.

Genus *Smynthurus* Lat.

I collected several specimens of this genus on pools of water after a hard rain, associated with a new species of *Isotoma;* one specimen from a tree in Cow Canyon and another specimen from Sycamore Hill, Laguna Beach, none of which I have yet been able to identify.

Family ENTOMOBRYIDÆ

This family is a large one, containing many genera as well as species and was the one found most commonly in this region. The genera differ greatly from each other and consequently by the later authorities have been divided into several sub-families.

Key to the Family ENTOMOBRYIDÆ

A. Body naked or covered with hairs.
  B. Two ocelli on either side of the head. Genus *Sinella*
  BB. Usually eight ocelli on either side of the head.
    C. Abdomen III and IV about equal in length. Genus *Isotoma*
    CC. Abdomen IV at least four times as long as III. Sub-Family Entomobryinæ
      E. Distal end of furcula curved, without anteapical tooth. Genus *Drepanura*
      EE. Mucro with two hooks. Genus *Entomobrya*

AA. Body covered with scales.
  B. Eyes twelve or none; antennæ ringed on III and IV. Sub-Family Tomocerinæ
    C. Eyes twelve. Genus *Tomocerus*
  BB. No antennal segments ringed.
    C. Ocelli wanting. Genus *Cyphodeirus*
    CC. Ocelli present.

Hesperia
Cajon Pass
Claremont
Edwards Sta
Reche
Deadman Cr.

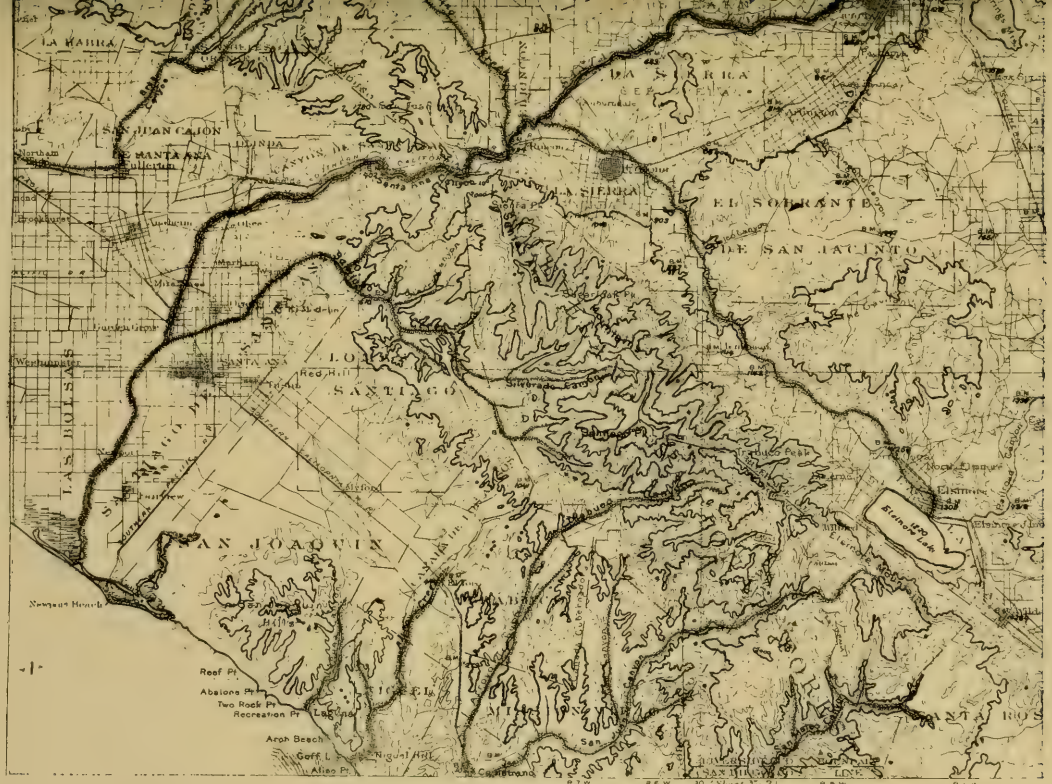

Figure 1. Map of the Claremont-Laguna region.

D. Pronotum simple, metathorax simple; saltatorial organ smooth; abdomen IV almost three times as long as III.

Genus *Pseudosira*

Genus *Sinella* Brook.

There is but one species of this genus known here so far and it is the same as that upon which the genus was founded, *curviseta*.

Sinella curviseta Brook.

(Plate I, Figs. 1-3)

Sinella curviseta Brook, on a new gen. of Coll. allied to Degeeria, 1882, p. 544. Collinge and Shoebotham, Jr. econ. biol. v, p. 114, 1910.

Description: Color—Opaque white. Antennæ long and slender; I short, II longer than III, IV equals II. Ocelli—Four, two on each side of the head, one behind the other, some distance apart. Claws—Two; superior long, curving slightly, armed with three teeth, the proximal large and opposite each other, the distal smaller; inferior short, stout, one-half length of superior; no tenent hairs. Furcula—Dentes and mucrones longer than manubrium, dentes serrated; mucrones small, long, teeth two and a long basal spine reaching nearly to the distal tooth. Segment of body greatly fused.

Variation: Those described by Collinge are yellow in color with mottlings of reddish pigment. There was no color on my specimens.

Habitat: Claremont, under flower pots in garden in September; Cucamonga Canyon; San Antonio Canyon, altitude 5000 feet, in black loam in grass roots.

Collinge found his in flower pots in a greenhouse in Berkhamsted.

Genus *Isotoma* Bourlet

So far this genus is represented in our fauna by eight species.

The body is sub-cylindrical with the abdominal segments subequal, in which respect it is different from *Entomobrya*. The antennæ are four-jointed, short, not much longer than the

head. In most species there are sixteen ocelli present. The postantennal organ is usually present and is of importance in species determination. The claws are two and often bear teeth on inner and outer margins. The furcula may be poorly developed or well developed and the mucrones are more highly developed in this genus than in any of the others.

Key to the Genus *Isotoma*

A. Furcula short, not reaching ventral tube.
  B. Mucrones bidenticulate.
    C. Claws unarmed; manubrium longer than dentes; antennæ little longer than the head; gray-blue or brown. *bidenticula*
    CC. Superior claw armed; dentes twice the length of the manubrium; antennæ same length as head; light green in color. *aquæ* n. sp.
  BB. Mucrones tridenticulate.
    C. Mucrones with second and third teeth opposite.
      D. Claws unarmed. *besselsii*
      DD. Claws armed; superior, two teeth on inner margin, two on outer; inferior, one tooth on inner margin. *aspera* n. sp.
    CC. Mucrones with second and third tooth not opposite, third tooth smaller; claws unarmed. *minima*

AA. Furcula reaching nearly or quite to the ventral tube.
  B. Mucrones, tridenticulate; no regular markings; inner margin of superior claw bidentate; postantennal organ ovate to oval. *viridis*
  BB. Mucrones quadridenticulate.
    C. Long pre-apical tooth, minute apical tooth; claws armed; length 3 mm. *catena*
    CC. Apical tooth of mucrones projecting as far as pre-apical. Dorsal median dark stripe. *palustris*

Isotoma bidenticula Guthrie

(Plate I, Figs. 4-5)

Isotoma bidenticula Guthrie, Coll. of Minn. geol. nat. hist. surv. of Minn., zool. series 4, pp. 1-110. Bacon, P. C. jr. ent. and zool., vol. IV, pp. 841-845.

Description: Length—1 mm. Color—Dark, dull brown, mottled; ventral side dark, light at the junction of the body segments, furcula and legs light. Antennæ—Short, little longer than head; I shortest, II longer than III, and IV longest. Ocelli—Sixteen. In each eye spot there are two which are smaller than the other six. Postantennal organ is present and elliptical. Claws—Unarmed. Furcula—Short, not reaching ventral tube; not slender and tapering; manubrium slightly longer than dentes and mucrones together. Mucrones—Bidenticulate; first tooth horizontal, long, slender, curving but slightly; second tooth vertical and curves slightly cephalad.

Variation: My specimens differ from those described by Guthrie in regard to the antennæ and ocelli. He describes antenna III as being longer than II and the ocelli in each eye spot all the same size.

Habitat: These were found in great numbers at Laguna Beach under the largest rocks below the mean tide mark at low tide.

Isotoma aquæ n. sp.

(Plate I, Figs. 6-9)

Description: Length—1.55 mm. Color—To the eye the specimens look light green but under the microscope they are a mottled blue and yellow. Antennæ—Short, same length as head; I, very short; IV, II and III all subequal. Postantennal organ—Present, large, an oval rim constricted in three places. Claws—Two; superior has a minute tooth about midway, in some specimens this only occurs on the last pair of legs and in others there is a small lateral tooth also; inferior unarmed, about one-half the length of the superior and dilated somewhat at the base; tenent hair present on tibia. Ocelli—Sixteen. Furcula—Short, not reaching the ventral tube; dentes and

mucrones over twice the length of the manubrium; dentes serrated on both edges; mucro bidenticulate, distal tooth is slightly curved and about the same length as the proximal one which is curved slightly cephalad, the axes of the two teeth almost parallel. Integument—Sparsely covered with short hairs.

Variation: The markings in this species are not at all regular and the color varies considerably with the yellow and brown predominating in some and the blue in others. There was a variation in the superior claw as mentioned above; however, there was no variation among the specimens in each locality.

Habitat: They were found in great abundance on pools of water in a newly plowed field after a hard rain; they were associated with a new species of Xenylla. Also I found them in San Antonio Canyon at Camp Baldy under rocks, and in the Ganesha Hills under the same condition, but they were not very abundant in either of these localities. Also they were found in San Dimas and Lytle Creek canyons.

Isotoma besselsii Packard

(Plate I, Fig. 10)

Isotoma besselsii Packard, 1877. Explorations of the Polaris Expedition to North Pole. Amer. nat. XI, 51-53. Packard, 1877, Amer. nat., p. 51-52 (footnote). MacGillivray, Can. ent. XXIII, p. 273. Davenport, 1903, Coll. of Cold Spring Beach, Cold Spring Harbor, mon. II. 1905 (Axelson) Linnanienii zur Kennt. der Aptery., vol. 7, vär. Bacon, P. C. jr. ent. and zool., vol. IV, pp. 843-845.

Description: In general appearance they look almost exactly like the *I. bidenticula,* although slightly smaller. Length—.75-1. mm. Color—Brown, yellow at junction of segments; furcula and legs light; ventral side dark. Antennæ—About as long as head; I shortest, IV longest, II and III subequal. Ocelli—Sixteen. Claws—Slightly curved; superior wide at the base but narrow at the apex; inferior with inner margin dilated at the base. Furcula—Short, stout, not reaching ventral tubes; manubrium slightly longer than dentes; mucro tridenticulate; distal tooth

long and but little curved, second and third teeth of about the same length, vertical, on opposite sides of the mucrones and nearly opposite each other.

Variation: MacGillivray described the antennæ, "First and second segments dilated, as broad as long and twice as broad as the third and fourth." In my specimens I is as broad as long, but this is not true of II. Also I and II are not as broad as III and IV.

Habitat: A very few of these specimens were found under the rocks during low tide at Laguna Beach.

C. B. Davenport has collected specimens from the sand at Cold Spring Beach, Massachusetts, and they have been taken from Spitzbergen, Polaris Bay, and Massachusetts Bay.

Isotoma aspera n. sp.

(Plate II, Figs. 1-4)

Description: Length—1.5 mm. Color—Great variation, dirty white with no markings to mottled gray. Antennæ—Longer than head, IV longest and thickest, II and III subequal, I little shorter than II and III. Ocelli—Widely separated, sixteen. Postantennal organ—Elliptical with a rim. Claws—Two; superior armed with two teeth on the inner margin, and two teeth on the outer margin; inferior, wide and stout, curved on the inner margin. Furcula—Does not reach ventral tube; dentes nearly three times manubrium; mucrones short and curving, tridenticulate, second and third teeth opposite. Integument—Very hairy.

Variation: The color varies a great deal.

Habitat: Camp Baldy, altitude 4700 feet, March. Lytle Creek, April; San Dimas, left fork.

Isotoma minima Guthrie

(Plate II, Fig. 5)

Isotoma minima Guthrie, 1903. The Collembola of Minnesota, Geol. and nat. hist. surv. of Minn. zool., series 4, pp. 1-110.

Description: Length—.75 mm. Color—Grayish blue. Antennæ—Short, little longer than head; IV longest and swollen;

II and III subequal; I one-half length of II. Ocelli—Sixteen. Postantennal organ—Long, elliptical, emarginate. Claws—Two, unarmed; superior curving slightly; inferior somewhat dilated at base; tenent hair present, long and simple. Furcula—Short, does not reach ventral tube; manubrium, stout and thick; dentes serrated and with mucrones about as long as manubrium. Mucrones—Tridenticulate, long and narrow; distal tooth almost straight, the antedistal and proximal parallel and at right angles to the distal tooth, proximal tooth smaller. Integument—Sparsely haired.

Habitat: A large number of specimens were found in a rotten log at the Chino swamps. Several specimens were also obtained from San Dimas Canyon. Guthrie found his in the greenhouse of the University of Minnesota under moist boxes, and outdoors under stones and damp boards.

Isotoma viridis Bour.

Podura viridis Bourlet, Mémoire Podurelles, p. 24, 1843.

Isotoma viridis, Bourlet, Mémoire Sco. Sc. Agri. arto. Lille. Pt. 1, p. 401, 1839. Gervais, in Walckenaer, Hist. nat. ins. Apt., III, p. 433, 1844. Lubbock, Mon. Coll. and Thys., p. 169, 1873. Parona, Laggio Catalogo Pod. Ital., p. 42, 1878; Ann. Mus. civ. st. nat. Genova, XVIII, p. 463, 1883. Reuter, Ofv. finsk, vet. soc. förk., XXXIII, p. 229, 1891. Schött, K. sven. vet. Akad. hand., XXV, no. 11, pp. 59-61, 1894. Dalla Torre, Die Hattungen und Arten der Apterygogeneam, p. 10, 1895. Reuter, Acta. Soc. Fauna Flora fenn., XI, pp. 25-26, 1895. MacGillivray, Can. ent., XXVIII, p. 58, 1896. Schäffer, Mitt. Naturk. Mus. Hamburg, XIII, pp. 184-186. Lie Pettersen, Bergens Mus. Aarb., No. 8, p. 17, 1897; ibid., no. 6, p. 12, 1898. Meinert, Videnak. Med. Naturk. Foren. Kjobenhaon, p. 169, 1897. Scherbakof, zool. Anz., XXI, p. 88, 1898. Carpenter and Evans, Proc. r. phys. soc. Edinburgh, XIV, p. 246, 1899. Wahlgren, Ofv. k. vet. Akad. Förk., LVI, p. 338, 1899. Kieffer, Berl. ent. Zeits., XLV, hft. 1-2, p. 113, 1900. Schäffer fauna, Artica. 1, lief. 2, p. 245, 1900. Guthrie, 1903.

Isotoma cærulea Bourlet, Mem. soc. sc. agri. Arts Lilla, p. 401,

1839. Gervais in Walckenaer, Hist. nat. ins. Apt., III, p. 433, 1844.

Isotoma arborea Bourlet, Mem. soc. sc. Agric. Arts Lille; Parona Laggio Catalogo Pod. Ital., 1878; Ann. mus. cic. st. nat. Genova, 1883.

Desoria virescens Nicolet, Recherches Podurelles, p. 59, 1841. Gervais, in Walckenaer, Hist. nat. ins. Apts., p. 248, 1844.

Desoria cylindrica Nicolet. Recherches Podurelles, p. 60, 1841. Gervais, 1844.

Desoria viatica Nicolet, 1841. Gervais, 1844.

Desoria pallida Nicolet, 1841. Gervais, 1844.

Desoria ebriosa Nicolet, 1841. Gervais, 1844.

Desoria annulata Nicolet, 1841. Gervais, 1844.

Desoria fusca Nicolet, 1841. Gervais, 1844.

Podura annulata Bourlet, Memoire Podurelles, p. 24, 1843.

Podura arborea Bourlet, ibid.

Isotoma desmarestii Gervais, in Walckenaer, Hist. nat. ins. Apt., III, p. 436, 1844.

Heterotoma chlorata, Gervais, ibid., p. 421, 1844.

Isotoma virescens Nicolet, Ann. soc. ent., 1847.

Isotoma pallida Nicolet, ibid.

Isotoma annulata Nicolet, ibid. Lubbock, mon. coll. and thys., pp. 175, 1873. Parona, Ann. Mus. civt. st. nat. Genova, XVIII, p. 463, 1883.

Isotoma fusca Nicolet, Ann. soc. ent. France, V. 1847. Lubbock, mon. coll. and thys., p. 175, 1873. Tömösvary, Math. term. kislem. Magyar Ak., XVIII, p. 124, 1882. Parona, Ann. mus. civ. st. nat. Genova, XVIII, p. 463, 1883; ibid., 2nd ser. VI, p. 143, 1888.

Isotoma anglicana Lubbock, Trans. linn. soc. London, XXVII, p. 506, 1862; mon. coll. and thys, p. 171, 1873.

Isotoma lineata Lubbock, Trans. linn. soc. London, XXIII, p. 597, 1862.

Isotoma palustris var. *unicolor* Tullberg, Ofv. k, vet. Akad. förk., XXVIII, p. 151, 1871.

Isotoma palustris var. *annulata* Tullberg, ibid.

Isotoma palustris var. *viridis* Tullberg, 1. sven. vet. Akad.

hand. X, p. 46. Uzel. Litzber, k. böh. Gesell, wiss. II, p. 63, 1891.

Isotoma palustris var. *fusca* Tullberg, k. sven. vet. Akad. hand., X, no. 10, p. 46, 1872. Uzel. Litzber, k. böh. Gesell, wiss., II, p. 63, 1891.

Isotoma belfragei Packard, Fifth Rep. Trust Peab. acad., pp. 33-34, 1873. MacGillivray, Can. ent., XXIII, p. 273, 1891.

Isotoma tricolor (in part) Packard, Fifth Rep. Trust Peab. acad., p. 34, 1873. MacGillivray, Can. ent. XXIII, p. 273, 1891.

Isotoma purpurescens Packard, Fifth Rep. Trust Peab. acad., pp. 34-35, 1873. MacGillivray, Can. ent., XXIII, p. 274, 1891.

Isotoma plumbea Packard, Fifth Rep. Trust Peab. acad., p. 35, 1873. MacGillivray, Can. ent., XXIII, p. 274, 1891.

Isotoma palustris Tullberg, Ofv. k. vet. Akad., förk., XXXIII, pp. 34-35, 1876.

Description: Length—5-6 mm. Color—Either yellow marked with purple or dark brown. Antennæ—Half as long again as the body; IV longest, II and III equal, I shortest. Ocelli—Sixteen. Postantennal organ—Ovate to oval. Claws—Superior, long, slender, tapering, armed with two teeth on the inner margin and one on the outer; inferior less than half as long, acute, apically curving, armed on inner margin; tenent hair unknobed. Furcula—Half as long as body; dentes nearly three times manubrium in length; mucrones tridentate with the teeth subequal, large, blunt; apical tooth falcate, second and third subfalcate and opposite each other. Integument—Dense, short curving setæ, with long barbellate hairs on the posterior part of the abdomen.

Variation: There is great variation in this species and I expect to consider this at another time.

Habitat: Found in great abundance in the entire region from the mountains to the sea.

Isotoma catena Guthrie

(Plate II, Figs. 6-7)

Isotoma catena Guthrie 1903. The Collembola of Minnesota, geol. and nat. hist. surv. of Minn. zool. series 4, p. 69.

Description: Length—3.8-5 mm. Color—"Dirty," obscure purple above, shading down laterally to a lighter tint, and showing brownish purple beneath. The antennæ are dark purple throughout; the legs rather a weak purple. The dentes and sometimes the legs as well, show a tendency to a yellow green tint. The head is dark throughout. Antennæ—Longer than the head; IV much more slender than III, I short and stout; II, III and IV subequal. Ocelli—Sixteen. Claws—Superior, long, curving but slightly, armed. One outer and two inner teeth; inferior, short, armed with one inner tooth; no tenent hairs. Furcula—Dentes more than twice the length of the manubrium; mucrones provided with four teeth, apical one is very small and at the base of the second, the other three are large, blunt; second tooth falcate, third and fourth subfalcate and nearly opposite each other. Clothing of dense short hairs with longer ones on the posterior end of the abdomen.

Habitat: Found with *Isotoma viridis* at Camp Baldy among leaves near the stream, and also in Palmer's and Bear canyons and at Laguna Beach, although not abundantly. Guthrie states that he did not find the species very abundant in Minnesota and took them from under the loose bark of a log on the bank of the Minnesota River and also at Lake Vermillion.

Isotoma palustris Müller

(Plate II, Figs. 8-10)

Podura aquatica cinerea De Geer, Act. soc. roy. Ups., 1740.

Podura palustris Müller, Zool. Dan. Prodr., p. 184, 1776. Gmelin, Linnæus, Sept. nat. ed. XIII, p. 2911, 1788. Bourlet, Mem. soc. roy. Douai, 1842. Bourlet Mem. sur les Podurelles, p. 29, 1843.

Aethescerus aquaticus Bourlet, Mem. soc. roy. Douai, 1842.

Podura psi. Herklots, Notices Entomologigues, 1837.

Isotoma palustris Tullberg, Lver. Podur., p. 45, 1872. Lubbock, Monogr. coll. and thys., p. 169, 1873. Uzel, Thys. Bohemiæ, p. 62, 1890. Schött, palaearct., coll., p. 63, 1893. Reuter, Finl. Coll., p. 26, 1895. Lie Pettersen, Norges Coll., p. 16, 1896.

Schäffer, Coll. der. Umgebung von Hamburg, p. 186, 1896. Folsom, Can. ent., XXVIII, p. 48, 1896. Guthrie, Coll. of Minn., p. 71, 1903.

Description: Length—2.5 mm. Color—Brownish yellow with median and transverse dark bands, dark spot on head and thorax II, and distal end of each segment of the antennæ purplish. Antennæ—Little longer than the head; I shortest, III longer than II, and IV longer than III and twice as long as II. Ocelli—Sixteen. Postantennal organ—Oval. Claws—Two; superior, stout, tapering but slightly; no teeth on inner margin but on second and third pair of legs there is a minute tooth; inferior, short, about one-half length of superior, dilated at base, armed with a minute tooth on inner edge; no tenent hairs present. Furcula—Does not quite reach ventral tube; dentes nearly three times as long as manubrium; mucrones four-toothed, first is minute and at the base of the second, second and third subequal, fourth arising from the side and extending caudalward, reaching beyond the base of the third tooth. Integument—Body set thickly with short, stout brown hairs of about an uniform length.

Variation: Mine differ from Guthrie's in that there is no green on the legs, ventral tube or furcula. In Guthrie's specimens antenna IV is more slender than III and seldom quite as long, in mine it is longer.

Habitat: Camp Baldy, altitude 4700 feet, January. Slippery Elm Ridge on slopes of Mt. San Antonio, altitude 7000 feet, December. This species has been reported from Europe, Asia, Africa and North America. Guthrie found them "on the surface of stagnant water, and on leaves and rubbish along the edge of lakes and streams during the whole summer; and in winter as well, when one can find a place where the snow is sufficiently melted to allow access to their haunts."

Genus *Drepanura,* Schött

I have found but one species of this genus.

This is essentially an Entomobryan with but one hook on the mucrones. The fourth segment of the abdomen is from

three to four times the length of the third. The ocelli are sixteen.

Drepanura californica Schött

(Plate II, Figs. 11-13)

Drepanura californica Schött, Kenntniss Kalifornischer Collembola, Bihang Till K. Svenska Vet., Akad. Handlinger, Band 17, Afd. IV, no. 8.

Description: Length—. Color—Yellow background with dark mottlings of blue, the proximal edge of thorax I, distal margin of thorax II, thorax III, abdomen I, and distal ends of antennæ IV, III and II, are dark; legs and furcula yellow. Antennæ—Longer than the head; I shortest, II and III subequal, IV longer than III. Ocelli—Sixteen. Claws—Two, both slender; superior armed with two teeth on the inner margin, straight, tapering gradually; inferior one-half length of superior, unarmed; tenent hair present. Furcula—Dentes plus mucrone equals manubrium, dentes serrated and covered with many plumed hairs; mucrones with one short falcate tooth, no anteapical teeth, short basal spine.

Variation: In the species described by Schött the mucrone is longer and more slender than mine and it doesn't have a basal spine.

Habitat: Bear Flats, altitude 6000 feet, November.

Genus *Entomobrya* Rondani

This genus is represented by five species in our fauna.

The Entomobrya have no scales and the segments of the abdomen are unequal, the fourth segment being from three to four times longer than the third. The ocelli are sixteen and there are no postantennal organs. The mucrones are small and always bear two teeth and sometimes a basal spine. The ventral tube is well developed. The claws are two and always armed. This genus is very common here.

Key to the Genus *Entomobrya*

A. Ocelli less than sixteen.

B. Ocelli six; greenish gray; superior claw armed with three teeth on the inner margin. *sexoculata*

B. Ocelli two; white; superior claw armed with two teeth on the inner margin. *binoculata*

AA. Ocelli sixteen,

B. Color yellow.

C. With distinct saddle-like dark markings covering thorax III and abdomen I, II, III. Superior claw armed with two teeth on the inner margin and one on the outer. *clitellaria*

CC. With well-defined dark crossbands around margin of thorax II, distal margin of thorax III, abdomen I, II, proximal margins abdomen IV, V, and VI; superior claw armed with one and sometimes two teeth on inner margin. *multifasciata*

C. Color other than yellow; mottled brown; superior armed with two teeth opposite each other. *laguna*

Entomobrya sexoculata Schött

(Plate III, Figs. 1-2)

Entomobrya sexoculata Schött, Proc. Calif. acad. sci. VI, p. 180, 1896.

Description: Length—1.5 mm. Color—Greenish gray in some and violet in others. Antennæ—Segments II, III and IV subequal. Ocelli—Six, three on each side of the head, two in the anterior group and one in the posterior. Claws—Superior armed with three teeth on the inner margin, the two basal ones being close together; the superior claws on the last pair of legs are armed with four teeth on the inner margin; inferior lanceolate and unarmed; one tenent hair dilated at the tip. Furcula—Long, dentes plus mucrones one and one-third longer than manubrium; mucrones with two teeth and a short basal spine. Integument—Body very hairy, many clubbed and geniculate hairs on head and thorax I and II.

Variation: Schött does not speak of any of his specimens having four teeth on the inner margin of the superior claw.

Habitat: Lytle Creek Canyon, March, San Dimas Canyon, November. Those described by Schött came from Berkeley and Alameda, California; Sonora, Mexico. So far it has never been reported outside of California and Mexico.

Entomobrya sexoculata Schött var ?

Description: This variety differs from *Entomobrya sexoculata* described by Schött in color, size and in the arming of the claws. Length—2 mm. Color—Mottled blue in some and brownish in others. Ocelli—Six, three on each side of the head. Claws—Superior armed with three teeth on the inner margin, the first and second being opposite each other, also small tooth on the outer margin. Mucrones—Two teeth with a short basal spine.

Habitat: Evy's Canyon, October; few.

Entomobrya binoculata Schött

(Plate III, Fig. 3)

Entomobrya binoculata Schött, 1896. N. Am. Apt., VI, p. 169. Bacon, 1913; A. Sp. of Coll. found with Termites, V.

Description: Length—1.5 mm. Color—Opaque white. Antennæ—Not as long as the body but longer than the head; antenna IV nearly twice the length of III, II and III about the same length, I shortest. Ocelli—Two, one on each side of the head; in some specimens there seems to be some indication of a bilobed condition of the eye spots. Claws—Two; superior is provided with three teeth, on the inner margin of which the two interior are very strong, and are placed beside each other; inferior is lanceolate and unarmed. Furcula—This does not quite reach the ventral tube, dentes slightly longer than manubrium; mucrones with two strong teeth and a slender basal one which points distally and almost reaches the middle tooth.

Habitat: Claremont, in twigs of live oak trees which were inhabited by termites; Cow Canyon, ant's nest; Sycamore Hill, Laguna Beach, under stones; Camp Baldy; Chino swamps. The species Schött described were found at Berkeley, California.

Entomobrya clitellaria Guthrie

(Plate III, Fig. 4)

Entomobrya clitellaria Guthrie, 1903. Coll. of Minn. geol. and nat. hist. surv. of Minn. zool. ser. 4, p. 75.

Description: Length—1.4 mm. Color—Orange yellow with the exception that there are dark markings on proximal edge of thorax I, distal margin of thorax II, thorax III, abdomen I, and proximal ends of antennæ IV, III and II, also dark markings between the eyes. Antennæ—Segments II, III and IV subequal. I much shorter and stouter. Ocelli—Sixteen. Claws—Two; superior armed with two well defined teeth on its inner edge; and one small one on outer which does not show on all specimens; inferior unarmed, slender, attaining to greatest width near its distal end, one tenent hair on tibia. Furcula reaches to ventral tube; dentes serrated with long hairs on its distal end; mucrones, small, two teeth with a basal spine. Abdomen IV five times as long at III.

Variation: Those described by Guthrie had saddle-like markings on abdomen II and the dorsal part of III. These were entirely lacking in mine. He believes this is a species varying but little in coloration, but there are considerable variations in my specimens, some of them having no markings except on the antennæ and head.

Habitat: Claremont, under leaves; Chino, on a tank platform twenty feet above ground, among moist mass of leaves. Guthrie obtained his specimens under bark of pine trees in woods in the northern part of Minnesota.

Entomobrya multifasciata Tullberg

(Plate III, Figs. 5-6)

Podura fasciata, Say., Jour. acad. Phil., II, p. 12, 1821.

Podura variegata Guer. and Per., Gen. des ins., 1838.

Podura simplex Koch, Fauna Ratesbonenais, Herrick. Schäffer's III, p. 354, 1840.

Podura striata Koch, ibid., p. 354, 1840.

Degeeria nivalis Nicolet, Soc. Helv., p. 70, 1841.

Degeeria lanuginosa Nicolet, Soc. Helv., p. 74, 1841.

Degeeria disjuncta Nicolet, Soc. Helv., p. 71, 1841.
Degeeria cortocalis Nicolet, Soc. Helv., p. 72, 1841.
Degeeria nivalis Lubbock, Notes on the Thys., p. 594, 1861.
Degeeria nicoletii Lubbock, Linn. soc. trans., p. 229, 1867.
Degeeria muscorum Tullberg, Fört. Ofv. Lv. Podur., p. 148, 1871.
Degeeria arborea Tullberg, Fört. Ofv. Lv. Podur., p. 148, 1871.
Degeeria marginata Tullberg, Fört. Ofv. Lv. Podur., p. 148, 1871.
Degeeria decemfasciata Packard, Thys. Essex Co., Mass., p. 40, 1873.
Degeeria pulchella Ridley, Ent. Mo. Mag., XVII, p. 270, 1881.
Entomobrya multifasciata Brook, Revis Gen. Ent., 1883. Uzel. Thys. Bohemiæ, p. 57, 1890. Schött, Palaearct. Coll., p. 49, 1893. Schäffer, Coll. V. Hamburg, p. 197, 1896. Collinge and Shoebotham, jr. econ. biol., V, p. 113, 1910. Guthrie, Coll. of Minn., p. 77.

Description: Length—1.5 mm. Color—Yellow with well-defined dark markings around margin of thorax II, distal margin of thorax III, distal margins of abdomen I, II, proximal margin abdomen IV, V and VI; distal ends of the antennæ segments I and II are also dark; anchor shaped mark on the head pointing distally. Antennæ—About half the length of the body, segments II, III and IV subequal. Ocelli—Sixteen. Claws—Two; superior armed with one tooth about the center of the inner margin, and usually there are two teeth. Small tooth on the outer margin, those taken from Laguna and San Diego were armed with three teeth on the inner margin; inferior lanceolate and unarmed. Furcula—Not passing the ventral tube; dentes plus mucrones longer than manubrium; mucrones, two teeth.

Variation: This species is quite variable and several varieties have been described as different species. Brook gives the most complete description of the markings. I find great variation in mine; the anchor-shaped mark was found only on the specimens from Laguna Beach.

Habitat: Chino swamps, rotten log; San Diego, flower pot; San Dimas Canyon, May. Claremont, Indian Hill; Laguna Beach, Sycamore Hill, February. This is one of the most widely distributed of the Collembola and occurs abundantly throughout Europe and the United States.

Entomobrya laguna Bacon
(Plate III, Figs. 7-9)

Entomobrya laguna Bacon, 1913. A New Sp. Coll. from Laguna Beach, Jr. ent. and zool., V, p. 202.

Description: Length—2 mm. Color—Dark brown mottlings with yellow ground color except on ventral side of body, furcula, thorax I, and the beginning of each segment; antennæ and legs dark blue. Antennæ—Three times as long as head; four segments subequal in length, IV longest, I shortest, II and III equal. Ocelli—Sixteen, eight in each eye spot, six large and two smaller ones. Claws—Two, wide at base and then become narrow and pointed; superior armed with two teeth opposite each other and at the end of the dilated portion; inferior armed on the outer side about midway with a very minute tooth not visible on some of the claws. On the three pairs of legs the claws vary somewhat; on the first the claws are about equal in length and both about equal in length and in width at the base, the inferior slopes abruptly into a point; on second pair the superior is the longest, the base of the inferior is not rounded but changes abruptly, making an angle; on last pair the claws are farther apart, equal in length and the inferior is more curved than on any of the others. Furcula—Dentes and mucrones a little longer than manubrium; dentes serrated and densely covered with plumed hairs; mucrones, two teeth, no base spine; distal tooth falcate. Integument—Body covered with fine hairs with many large geniculate ones on the anterior part of the body and short clubbed ones on the last segment of the abdomen.

Habitat: Laguna Beach, on the under side of large rocks as far out in the water as it was possible to turn over the stones. They were very abundant and were collected in great numbers during July to September.

Genus *Tomocerus* Nicolet

This genus seems so distinct from the other members of the family Entomobryidæ that some good authorities recognize a family Tomoceridæ.

The eyes are twelve, six on each side of the head. The antennæ are long but do not exceed the body in any of my species. The third and fourth segments of the antennæ are subdivided in short rings. The claws are armed and the teeth simple. The tenaculum does not vary greatly, the base bears anterior setæ which differ somewhat. Each dentes is divided by two transverse sutures into three regions and there are spines on the middle and proximal regions. These spines furnish good specific characters. The form of the mucrone is distinctive of Tomocerus. Each bears, on the closed side, two large proximal teeth, an apical tooth and a series of small intermediate teeth.

I have a large number of specimens of this genus but they vary so from those described by Folsom (1913) that I am not sure that I have more than two species. Folsom uses the dental spines as one of the principal characters for distinguishing the species. But among my specimens I am unable to find even two that have the number and arrangement of the spines the same. Therefore I cannot use them entirely in classification.

Key to the Genus *Tomocerus*

A. Intermediate dental spines unequal, with a large spine near the middle of the series; one large distal spine.
  B. Teeth of superior claw, four to seven.
    C. Dental spines simple. *vulgaris*
  BB. Teeth of superior claw, two. *bidentatus*

Tomocerus vulgaris Tullberg

(Plate IV, Fig. 1)

Macrotoma vulgaris Tullberg, 1871; 1872. Uzel, 1890.

Tomocerus plumbeus Packard, 1873.

Tomocerus vulgaris Tullberg, 1876. Reuter, 1891; 1895. Brook, 1883. Dalla Tovre, 1888. Schött, 1894. Schäffer, 1896, 1900a; 1900b. Poppe and Schäffer, 1897. Scherbakov, 1898.

Carpenter and Evans, 1899. Carl, 1899. Skorikow, 1900. Absalon, 1903. Börner, 1901. Krausbauer, 1901. Agren, 1903. (Axelson) Linnaniemii, 1905, 1907, 1912. Wahlgren, 1906b.

Podura vulgaris Vorgts, 1902.

Tomocerus niger Guthrie, 1903.

Description: Length—4 mm. Color—Blue, when denuded of scale, yellow. Antennæ—Two-thirds as long as the head and body. Ocelli—Twelve. Claws—Superior armed with four to six teeth on inner margin; inferior lanceolate and armed with a minute tooth. Dental spines seventeen to twenty-three on each side. Mucrones from five to seven intermediate teeth.

Variation: In speaking of the dental spines of this species, Folsom (1913) gives usually thirteen to fifteen in number, and rarely seventeen or eighteen. The majority of mine had nineteen to twenty-one.

Habitat: Cucamonga Canyon, Palmer's Canyon, Fern Canyon, San Antonia Canyon; altitude 7000 feet.

Tomocerus bidentatus Folsom

(Plate IV, Figs. 2-3)

Tomocerus bidentatus Folsom, 1913. Proc. U. S. Nat. Mus., vol. 46, pp. 451-472.

Description: Length—2 mm. Color—Yellow, mottled with dark pigment. Antennæ—Shorter than body. Ocelli—Sixteen. Claws—Superior stout, armed with two teeth; inferior lanceolate. Dental spines sixteen. Mucrones with four to seven intermediate teeth.

Habitat: Palmer's Canyon.

Genus *Cyphodeirus*

Only one species of this genus has been found here. It is really a white, eyeless Entomobrya with scales. *albinus*

Cyphodeirus albinus Nicolet

(Plate IV, Figs. 4-5)

Crystalpoduran O. Fabricus, 1783. Danske V. denck., p. 303.

Cyphodeirus albinus Nicolet, 1842. Hist. des Podurelles, p. 67.

Lepidocyrtus albinus Gervais, 1844. Hist. nat. ins., Walckenaer, vol. III.

Lepidocyrtus albinus Lubbock, 1867, Notes on Thys., pt. III, p. 301.

Cyphodeirus albinus Tullberg, 1871, Fört. Ofv. sv. Podur., p. 103.

Cyphodeirus albinus Tullberg, Sver. Podur., p. 38.

Beckia albinus Lubbock, 1873, Monogr. Coll. and Thys., p. 49.

Cyphodeirus albinus Uzel, 1890, Thys. Bohem., p. 49.

Cyphodeirus albinus Schött, 1893, Palearctic, Coll., p. 44.

Cyphodeirus albinus Reuter, 1895, Finl. Coll., p. 16.

Cyphodeirus albinus Schäffer, 1896, Coll. V. Hamburg, p. 199.

Tullbergia immaculata, Lie-Pettersen, 1896, Norg. Coll., p. 16.

Cyphodeirus albinus Guthrie, 1903, Coll. of Minn., p. 82.

Cyphodeirus albinus Collinge and Shoebotham, 1910, Apterygota of Hert., p. 119.

Description: Length—1 mm. Color—White. Antennæ—Short, slightly longer than head; I shortest, II pear shaped and longer than III, IV as long as II and III. Ocelli—Wanting. Claws—Two; superior armed, two teeth on inner margin, the basal one being the longest; inferior runs out in two diverging points; one simple tenent hair on the tibia. Furcula—Dentes longer than manubrium and twice the length of the mucrones; mucrones with two teeth and a short basal spine.

Variation: Those I have found here do not vary among themselves but differ in some instances from those described by other authors. Lie-Pettersen gives the size of those he described as 1.5 mm. and those of Guthrie correspond to this. I didn't find any that were quite that large. Lie-Pettersen seems to have overlooked the smaller tooth on the superior claw and Collinge the same, for it does not appear in either of the descriptions.

Habitat: Claremont, under a rock. This was the only place that I found them. Nicolet says that they "inhabit worm-eaten trunks" and Collinge found his in ants' nests, while Guthrie found them very common among damp decaying leaves

in the woods of Minnesota. They have been reported from Finland, Scandinavia, Bohemia, Germany and Minnesota.

Genus *Pseudosira* Schött, Börner

This is a scaled genus similar to Entomobrya, one species is found here, and has been described by Lubbock from England. They seem to live in much dryer places than the other Collembola.

Pseudosira domestica Nicolet

Degeeria domestica Nicolet, Rech. p. s. á l' hist. d. Pod., 1842, p. 76.

Seira domestica Lubbock, Monograph, 1873, p. 144.

Pseudosira domestica Collinge and Shoebotham, jr. econ. biol, V, 1910, p. 115.

Description: Length—2.65 mm. Color—Steel blue with some brown. Antennæ—Slender, long; I shortest, II and III subequal; IV not quite twice as long as III but little over twice as long as I. Ocelli—Sixteen. Claws—Two, both slender, superior three teeth, inferior unarmed; tenent hair on tibia. Furcula—Long and slender, dentes plus mucrones longer than manubrium, dentes serrated; mucrones, one tooth with basal spine. Abdominal segments unequal; IV almost three times as long as III.

Variation: Those described by Collinge had no basal spine while mine have.

Habitat: Found under a rotten log in fairly dry sand in Cucamonga Canyon. Nicolet in describing this species, says that it is found in houses and is very rare. Collinge found it on and under flower pots in a greenhouse.

Family PODURIDÆ

This family is a large one and is less specialized and more primitive than the Entomobrya. The antennæ are short and many of them have sense bulbs at the end. Ringed antennæ are entirely unknown. The claws show reduction. In some genera the inferior claw is little more than a bristle, while in

others it is absent entirely, still others have the claws well developed. The furcula is usually short and weak, in some species it is so short that it is hard to see that there is any. But two of the genera of this family have been found in this region.

Key to the Family PODURIDÆ

A. Feet two-clawed; two anal horns; postantennal organ present; ocelli, sixteen. Genus *Achorutes*

AA. Feet with a single claw; no postantennal organ present; two anal horns; ocelli, ten; furcula short but very slender. Genus *Xenylla*

Genus *Achorutes* Templeton, Schäffer

The tarsi have two claws. The ocelli are sixteen, the antennæ short and four-jointed. The post antennal organ is present, pseudocelli are absent. The body is cylindrical with the segments subequal. The furcula is stout with a heavy manubrium and a thick dentes that tapers but little. The anal horns are sometimes long and curving, while again hardly visible.

Our two species of this genus are both new.

Key to Genus *Achorutes*

A. Anal horns long, two times papillæ, dentes with spikes, mucro lamellate with two teeth. *californica* n. sp.

AA. Anal horns long, four times papillæ, dentes without spikes; mucrones, lamellate, with a raised rim on distal end, no teeth. *citri* n. sp.

Achorutes californica n. sp.

(Plate IV, Fig. 6-11)

(Plate V, Fig. 1)

Description: Length—1.5 mm. Color—Yellow with brown spots, black spot in middle of the head between the eyes. Antennæ—Length of head. Ocelli—Sixteen. Postantennal organs—Composed of five tubercles on each side, the two largest are oval and have their long axis at right angles to the

antennæ, the other three tubercles are grouped behind, the center one being round and the other two oval with their long axes parallel to the axes of the antennæ, those on each side differ slightly. Claws—Two; superior very stout and slightly curving, armed with a tooth situated about midway on the inner margin; inferior about one-half length of superior, dilated at base, interrupted half way, making a sharp angle and ending in a spine; one long, simple, straight tenent hair. Furcula—Dentes is twice the length of the mucrones, bears six long hairs or spines, the shortest one being next to the mucrones and the others gradually becoming longer; mucrones have two teeth. Anal horns—Two, twice the length of the papillæ, stout and curving. Integument—One long spine to each segment, except at the posterior end of the abdomen where they are more numerous, also two or three short curved ones on each segment.

Habitat: West Fork of Palmer's Canyon, in the gills of mushrooms (*Marasmius*), very abundant; mouth of Ice House Canyon, altitude 5000 feet, among pine needles; Camp Baldy, altitude 4700 feet, in rotten log; Chino swamps.

Achorutes citri n. sp.

(Plate V, Figs. 2-5)

Description: Length—1.5 mm. Color—Steel blue. Antennæ—Shorter than head. Ocelli—Sixteen. Postantennal organ—Four tubercles on each side of the head, oval to elongate. Claws—Two; superior very long and curving, armed with one tooth about midway; inferior dilated at the base, forming a right angle, and extends as a long seta two-thirds the length of the superior. Furcula—Mucrones broad, lamellate, rounded at distal end with a rim. Anal horns—Extremely long, sharp, four times length of papillæ.

Habitat: Found in great abundance in a flume in an orange orchard near Claremont, also the rotten oranges were covered with them; January.

Genus Xenylla Tullberg

This genus is characterized by the absence of the inferior claws and postantennal organs; by having the ocelli reduced

to ten; the presence of anal horns, and a small, weak furcula. The genus is not a large one but three species have been found here, one of which Prof. Folsom will probably describe later.

Key to the Genus *Xenylla*

A. Mucrones lamellate, color yellow with blue semicircular spots, claws slightly curved. *collis* n. sp.

AA. Mucrones narrow, slender and tapering.

B. Mucrones straight, no hook; claws slightly curved, two tenent hairs; anal horns short, little longer than papillæ; color, steel blue. ..... n. sp.

BB. Mucrones notched, forming a hook; claws greatly curved, one tenent hair; anal horns two, short; color, yellow with dark spots. *paludis* n. sp.

Xenylla collis n. sp.

(Plate V, Figs. 6-8)

Description: Length—1.3 mm. Color—Yellow background with blue semi-circular spots on it; these are fairly far apart and not dense. Antennæ—Segments III and IV fused, I shortest; same length as head. Ocelli—Ten, five on each eye spot. Claws—One, slightly curving and fairly stout, two long tenent hairs. Furcula—Very short, only reaching about one-third distance to ventral tube; mucrones, lamellate. Anal horns—Two, short, curved, on separate papillæ close together, a trifle longer than papillæ. Integument—Finely granular, hardly any long spines except two or three at the posterior end, most of the hairs short and slightly curved.

Habitat: Pomona, Ganesha Park, under bark of alder tree, February.

Xenylla ..... n. sp,

To be described later.

Habitat: Claremont, on pools of water in a newly plowed field after a hard rain; February. Cucamonga Canyon, in the soil under leaves.

Xenylla paludis n. sp.

Description: Length—1.3 mm. Color—Yellow with dark spots. Antennæ—Shorter than head. Ocelli—Ten, five on each side of the head. Claws—One, unarmed, short and greatly curved; tenent hairs, one. Furcula—Short, slender and weak. Mucrones, one small hook. Anal horns—Two, short, little longer than papillæ.

Habitat: Chino swamp, April, in rotten log.

Family APHORURIDÆ

These are the most primitive of the Collembola, lacking the furcula. They are slow-moving, sluggish, and are found mostly in the moist soil or rotten wood. Three genera of this family are represented here.

Key to the Family APHORURIDÆ

A. Dorsal side of the body with large tubercles; abdomen ending in four rounded tubercles; postantennal organ present or absent. Genus *Neanura*

AA. Dorsal side of the body without large tubercles. Pseudocelli present, postantennal organ present.

B. Feet with two claws, anal horns none or two. Genus *Aphorura*

BB. Feet with one claw, anal horns two or four, postantennal organs placed in rows. Genus *Tullbergia*

Genus *Neanura* MacGillivray

The neanuras are sluggish insects and may easily be recognized by the broad flat shape of the body and the large tubercles. They are found usually in moist rotten wood.

Only one species of this genus has been found here and it is not the one that is found almost all over the world but one that has been reported from the Arctic region.

Neanura gigantea Tullberg

Anura gigantea Tullberg, Ofv. k. vet. Akad. förk., XXXIII, no. 5, p. 41. Schött, k. sven. vet. Akad. hand., XXV, no. 11, p. 94, 1894.

Neanura gigantea Schäffer, Fauna Artlica, 1, laf. 2, p. 240, 1900. Folsom, papers from Harriman Alaska Expd., XXVII, p. 87, 1902. Bacon, P. C. jr. ent. and zool., vol. VI, p. 46.

Description: Length—3.5 mm. Width—1.5-2.5 mm. Color—Dark blue, lighter on the ventral side. Body—Broad, flat, covered with long dark tubercles, the numbers on each successive segment being: six, eight, eight, eight, eight, eight, eight, six, two. Each tubercle bears several long setæ. Head—A little longer than the first two segments together, twice as broad as long, with thirteen tubercles. The head is divided into two parts, a raised upper portion with five small tubercles and two large tubercles containing the eyes, and a lower portion with six large tubercles. Antennæ—Short, half as long as the head, conical, with segments related in length as 4:3:2:6; on the dorsal side it is hard to distinguish more than three segments, but four show plainly on the ventral side; basal segment is round, the terminal one is as long as the other three together; no sense bulbs. Ocelli—Five in each eye spot, situated on a tubercle with three large setæ. Postantennal organs—Each composed of more than 100 clavate papillæ forming a rosette. Claws—One, short, stout, curved, armed with a minute tooth about midway; minutely tuberculate. Anal horns—Wanting. Integument—Finely tuberculate and covered with large tubercles bearing stiff yellow setæ.

Variation: My specimens seem to be the same as those described by Dr. Folsom except that they have one more tubercle on the anterior part of the head; this is constant in all my specimens.

Habitat: Cucamonga Canyon, rotten piece of wood, in November; Fern Canyon, under rocks. Palmer's Canyon, under rocks. Pomona hills, December, and Chino Hills, January, under rocks. Eucalyptus Hill, Laguna Beach, under rocks, March; Live Oak Canyon, January.

Tullberg and Schött have recorded this species from several localities in Siberia, Yenisei River, and vicinity of St. Lawrence Bay. Tullberg is confident that it does not occur in Nova Zembla, Spitzbergen or Greenland.

Genus *Aphorura* MacGillivray

These insects are small and white, without eyes, and with an inferior claw. The postantennal organs are present and also the pseudocelli. They are very abundant in soil and under stones.

Key to the Genus *Aphorura*

A. Anal horns wanting. ..... sp. ?

AA. Anal horns two.

B. Color yellow, each postantennal organ composed of nine tubercles. *lutea*

BB. Color white. Each postantennal organ composed of eleven tubercles. *montis*

Aphorura ..... sp. ?

I have been unable to identify this species.

Description: Color—White. Antennæ—Shorter than head; antennæ sense bulbs present, five at the distal end of the third segment, and two blunt curved hairs at the distal end of segment IV. Eyes—Wanting. Postantennal organ—Present. Pseudocelli—Present; two at the base of each antenna, two on the anterior portion of the head, four on the posterior portion, six on thorax II and III, four on abdomen I; six, abdomen II, III, IV; ten, abdomen V; two, abdomen VI. Claws—Two, unarmed; superior tapers quickly to a sharp point; inferior, dilated at base, ending in a seta reaching to end of superior claw. Anal horns—Absent. Integument—Finely granular, hairs few, short and straight.

Habitat: In dirt underneath fern in San Antonio Canyon above Ice House Canyon; altitude 5000 feet; few; December.

Aphorura lutea Bacon

Aphorura lutea Bacon, 1913. P. C. jr. ent. and zool., vol. V, pp. 43-46.

Description: It closely resembles *Aphorura montis* in general appearance, length, size and shape of the body. It differs though in color and the postantennal organ. Color—Yellow Antennæ—Shorter than head. Two rows of antennal organs on

III and one on IV. Ocelli—Wanting. Postantennal organs—Elliptical; composed of nine tubercles, five on the antennal side and four on the other. Pseudocelli—One at the base of each antenna. Claws—Two, unarmed. Anal horns—Two, same length as papillæ upon which they are situated. Integument—Finely tuberculate, and sparsely covered with short hairs.

Habitat: Bear Flats, altitude 6000 feet, in rich soil at the base of a clump of bushes; very abundant.

Aphorura montis Bacon

Aphorura montis Bacon, 1913. P. C. jr. of ent. and zool., vol. V, pp. 43-46.

Description: Length—1.3 mm. Color—White. Antennæ—Shorter than head, blunt; I shortest, II and III subequal; IV longest; antennal organs on III and IV, those on IV are composed of seven blunt processes; those on III are wider and composed of five processes, the ones on the outside being the longest and thickest. No eyes. Postantennal organs—Elliptical, composed of eleven raised tubercles, six on the side toward the antennæ. Pseudocelli of the head—One at the base of each antennæ. Claws—Two, unarmed; superior long and broad; inferior very short and narrow. Abdomen—Segments V and VI longest, others subequal. Anal horns—Two, situated on papillæ which are separated, about same length as papillæ. Integument—Sparsely covered with sort hairs, cuticle finely tuberculate.

Habitat: Bear Flats on the slope of Mt. San Antonio, 6000 feet altitude, in the soil at the base of buckthorne bushes; April.

Genus *Tullbergia*

In the genus *Tullbergia* the ocelli are wanting, the postantennal organ is present composed of a great many tubercles, pseudocelli are present and the anal horns longer than the papillæ. These insects are white and are very long and slender.

Key to the Genus *Tullbergia*

A. Anal horns, two. ..... *collis*
AA. Anal horns, four. ..... n. sp. ?

Tullbergia collis Bacon

Tullbergia collis Bacon, P. C. jr. ent. and zool., vol. VI, pp. 84-85.

Description: Length—1.5 mm. Width—.3 mm. Color—White. Body—Long and slender, sparsely covered with short hairs, only two or three to a segment except at the posterior end, where there are numerous long straight bristles; segments somewhat fused. Antennæ—Shorter than head, segments subequal. Eyes—Wanting. Postantennal organ—Present, consisting of a transverse groove with four rows of tubercles with more than twenty in each row; around the outside in some specimens there is a band of modified tubercles which surround the organ. Pseudocelli—Present, one at the base of each antenna, two on posterior end of head, two on each segment of the body except the last one. Claws—One, stout, slightly curved. Anal horns—Two, situated on papillæ which are separated at the base; longer than the papillæ and about the same length as the claw.

Habitat: This species was taken in the hills near Pomona and Laguna Beach. This is the first time this genus has been reported from the United States.

Tullbergia ..... n. sp. ?

So far I have been unable to determine the species of this specimen, it is probably new and may even be a new genus. This species is very long and narrow and distinguished by the four anal horns.

Description: Length—1-1.4 mm. Width—.16 mm. Color—White. Body—Very long and slender. Antennæ—Shorter than head, segments III and IV fused. Eyes—Wanting. Postantennal organ—Transverse to the long axes of the body, large and elliptical, elongated, composed of very many minute papillate elements. Pseudocelli—Present, one at the base of each antenna. Claws—One, unarmed. Anal horns—Four; the two anterior ones are farther apart and shorter than the two posterior ones; over twice the length of the papillæ upon which they are situated. Integument—Finely granular; body covered with short hairs, only two or three to a segment.

Habitat: Under a rock in the Ganesha Hills; few.

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(Contribution from the Zoological Laboratory of Pomona College.)

EXPLANATION OF PLATE I.

Figure 1. Right eye patch, *Sinella curviseta* Brook.
Figure 2. Claws, *Sinella curviseta* Brook.
Figure 3. Mucro, *Sinella curviseta* Brook.
Figure 4. Claws, *Isotoma bidenticula* Guth.
Figure 5. Mucro, *Isotoma bidenticula* Guth.
Figure 6. Mucro, *Isotoma aquae* n. sp.
Figure 7. Postantennal organ, *Isotoma aquae* n. sp.
Figure 8. Ocelli, *Isotoma aquae* n. sp.
Figure 9. Claws, *Isotoma aquae* n. sp.
Figure 10. Mucro, *Isotoma besselsii.*

EXPLANATION OF PLATE II.

Figure 1. Claws, *Isotoma aspera* n. sp.
Figure 2. Mucro, *Isotoma aspera* n. sp.
Figure 3. Left eye patch, *Isotoma aspera* n. sp.
Figure 4. Postantennal organ, *Isotoma aspera* n. sp.
Figure 5. Mucro, *Isotoma minima* Guth.
Figure 6. Mucro, *Isotoma catena* Guth.
Figure 7. Claws, *Isotoma catena* Guth.
Figure 8. Claws, *Isotoma palustris* Muller.
Figure 9. Mucro, *Isotoma palustris* Muller.
Figure 10. Antenna, *Isotoma palustris* Muller.
Figure 11. Claws, *Drepanura californica* n. sp.
Figure 12. Mucro, *Drepanura californica* n. sp.
Figure 13. Left eye patch, *Drepanura californica* n. sp.

EXPLANATION OF PLATE III.

Figure 1. Right eye patch, *Entomobrya sexoculata* Schött.
Figure 2. Claws on last pair of legs, *Entomobrya sexoculata* Schött.
Figure 3. Claws, *Entomobrya binoculata* Schött.
Figure 4. Claws, *Entomobrya clitellaria* Guth.
Figure 5. Claws, *Entomobrya multifasciata* Tullb.
Figure 6. Left eye patch, *Entomobrya multifasciata* Tullb.
Figure 7. Claws of first pair of legs, *Entomobrya laguna* Bacon.
Figure 8. Claws of second pair of legs, *Entomobrya laguna* Bacon.
Figure 9. Claws of third pair of legs, *Entomobrya laguna* Bacon.

EXPLANATION OF PLATE IV.

Figure 1. Claws, *Tomocerus vulgaris* Tullb.
Figure 2. Claws, *Tomocerus bidentatus* Folsom.
Figure 3. Spines of left dentes, *Tomocerus bidentatus* Folsom.
Figure 4. Claws, *Cyphoderus albinus* Nic.
Figure 5. Antenna, *Cyphoderus albinus* Nic.
Figure 6. Right eye patch, *Achorutes californica* n. sp.
Figure 7. Claws, *Achorutes californica* n. sp.
Figure 8. Setæ near median dorsal line of thorax, *Achorutes californica* n. sp
Figure 9. Left postantennal organ, *Achorutes californica* n. sp.
Figure 10. Right postantennal organ, *Achorutes californica* n. sp.
Figure 11. Anal horn, *Achorutes californica* n. sp.

EXPLANATION OF PLATE V.

Figure 1. Mucrone, *Achorutes californica* n. sp.
Figure 2. Mucrone, *Achorutes citri* n. sp.
Figure 3. Anal horn, *Achorutes citri* n. sp.
Figure 4. Left postantennal organ, *Achorutes citri* n. sp.
Figure 5. Setæ near median dorsal line of thorax, *Achorutes citri* n. sp.
Figure 6. Claw, *Xenylla collis* n. sp.
Figure 7. Setæ near median dorsal line of thorax, *Xenylla collis* n. sp.
Figure 8. Mucrone, *Xenylla collis* n. sp.

Plate I


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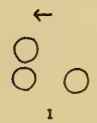
Plate II



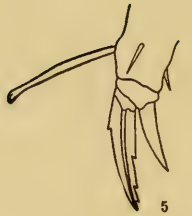
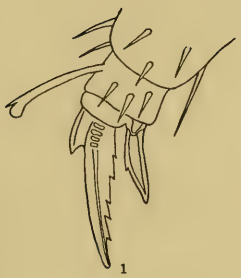
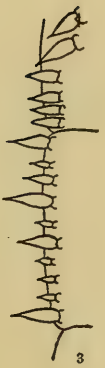


Plate III





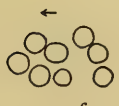


Plate IV

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Plate V

Wants and Exchanges

Subscribers and others are urged to use these columns to make their wants known. As the Journal goes to all parts of the world we hope to make this a very useful feature of the publication. Exchange notes are free to subscribers.

WANTED—Myriopods from all parts of the world. Will name, exchange or purchase. R. V. Chamberlin, Mu. Comp. Zoology, Harvard Univ., Cambridge, Mass.

Will exchange insects of any order from Southern California, for Microlepidoptera from any part of North America, preferably pinned, with complete data concerning capture. Fordyce Grinnell, Jr., Pasadena, Cal.

COCCIDÆ—California Coccidæ exchanged for specimens from all parts of the world. E. O. Essig, Secretary State Commission of Horticulture, Sacramento, Cal.

WANTED—Cephalopods (in alcohol); Chitons (in alcohol or dry); shells of West American Mollusca; zoological literature. Offered: West American and other molluscan shells; zoological pamphlets, mainly on the Mollusca. S. S. Berry, 502 Cajon St., Redlands, California.

California Syrphidæ, Aphididæ to exchange for non-California Syrphidæ. W. M. Davidson, Walnut Creek, Cal.

WANTED—For exchange, papers on marine and fresh-water Protozoa. Albert L. Barrows, Department of Zoology, University of California, Berkeley, Cal.

WANTED—Information on any mite-papers for sale or exchange that have an economic bearing. H. V. M. Hall, Room 8, Court House, San Diego, Cal.

WANTED—Specimens and separates relating to the pseudoscorpions, in exchange for local species. M. Moles, Claremont, Cal.

WANTED—Literature and determined specimens of Collembola, in exchange for local forms and literature. G. Bacon, Claremont, Cal.

WANTED—Determined specimens of Thysanura in exchange for local species. R. Gardner, Claremont, Cal.

WANTED—Separates relating to the nervous system and sense organs of the invertebrates in exchange for reprints by a number of authors on this and other topics relating to the anatomy of invertebrate animals. W. A. Hilton, Claremont, Cal.

Tabanidæ from all parts of North America to exchange for Tabanidæ from the Western United States and Mexico and Central America. Jas. G. Hine, Ohio State University, Columbus, Ohio.

Pseudoscorpions in the Claremont-Laguna Region

MARGARET M. MOLES

Many individuals may be found in a certain vicinity. In the valleys where oak and sycamore trees grow abundantly there can be found as many as seventy-five on the lower trunk of one tree. They are all of one or two species. In all the student collections that have been carried on here in college for the last ten years there have never been more than four or five species collected. It was only through special collection that the other species were found. Very few were found under stones, where they are so often spoken of as living, and few were found among fallen leaves. Some were collected in rotten poplar and pine logs. In the marshy ground at Chino they were found under leaves and stones and were very abundant on the poplar trees.

The distribution of the pseudoscorpions extends from an altitude of 5000 down to within ten feet of the ocean.

Concerning their habits of living little can be found. Many small spiders were found in their claws, also the small mites that live underneath the bark of trees. Several experiments were tried with some that were brought into the laboratory. The results were:

1. The pseudoscorpions would not go into Eucalyptus bark.
2. They could not live in a glass dish if water was not placed in it somewhere. If water was left out, they would dry up within twenty-four hours.
3. They avoided the sunlight and would go under cover.
4. They would remain in one spot without moving for a day at a time.

Chelifer cancroides Linn

Description: Length—including mandibles, 3 mm.; pedipalps, 4 mm.; claw, 1.5 mm. Color—Pedipalps, dark reddish brown; cephalothorax, dark reddish brown; abdomen, lighter than the palps and cephalothorax; legs, light yellow brown.

Cephalothorax: Evenly rounded in front; one distinct median suture, two distinct eye spots.

Abdomen: Twice as long as it is broad and divided into eleven distinct sutures. All of the scuta about the same size except the last one, which is a great deal shorter and broader than the rest. Each scutum is provided with two strong, spiny hairs on the outer edge.

The whole body is heavily granulated, the cephalothorax having knob-like protuberances all along the edges.

Pedipalps: Larger than the whole animal. Coxa, smooth; trochanter with large protuberance ending in a heavy spine on the outer edge. Femur longer than cephalothorax, pedicellate. Tibia, concave on inner edge, pedicellate, shorter than femur. Trochanter, femur and tibia strongly granulated and sparsely covered with almost clavate hairs. Claw of good size, finger a little shorter than the hand. Hand evenly convex on outer and inner edges. Finger slightly curved, smooth, with many long simple tactile hairs.

Mandibles: Small, fixed finger provided with many small teeth. Serrula attached throughout length of moveable finger. Spinnerets long and transparent. Mandibles are provided with five or more heavy long hairs.

Flagellum: Divided into four separate parts.

Legs: First two with trochantins, claws simple, legs covered with almost clavate hairs.

Habitat: Barns or buildings of this community; also found in some of the common trees, such as the oak and sycamore. This was collected in Whittier, Claremont, Lytle Creek and San Antonio canyons, and the smaller canyons near Claremont.

Chelifer fuscipes Banks. Figs. 1 and 2

Description: Length of animal, including mandibles, 4 mm.; pedipalps, 5.5 mm.; claw, 2 mm. Color—Pedipalps, reddish brown; cephalothorax, reddish brown; abdomen and legs, light brown.

Cephalothorax: As long as it is broad. Upper edge almost truncate, yet rounded; sides evenly convex, lower edge almost straight. Cephalothorax finely granulate and heavy, simple spine-

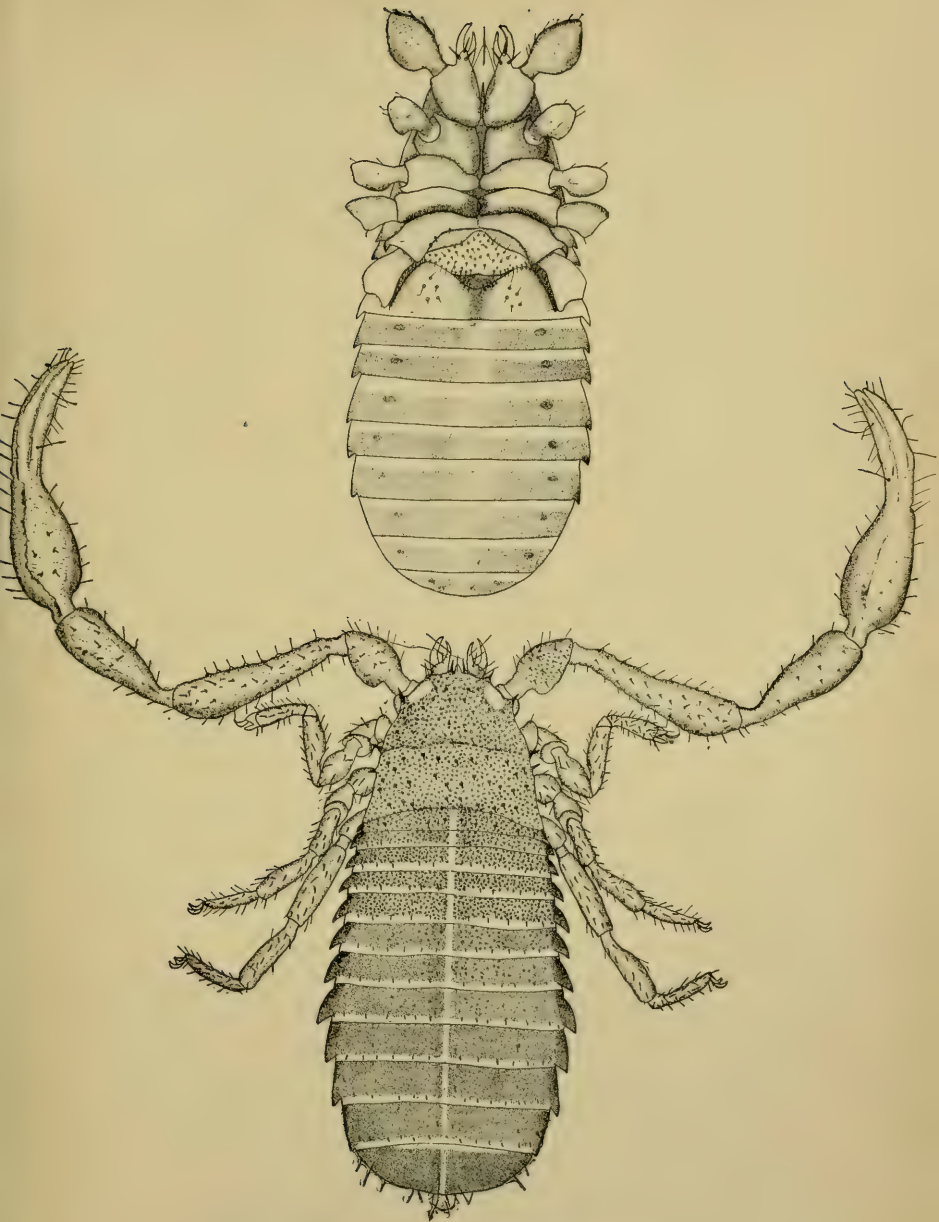


Figure 1. *Chelifer fuscipes* Banks. From below and above. ×25.

Figure 2. *Chelifer fuscipes,* third leg and mandible much enlarged.

like hairs placed in a definite order. One distinct median suture. Two eye spots.

Abdomen: Half as broad as it is long and divided into twelve scuta. The outer edges of each scutum are prolonged into curved hooked spines. The first scutum is the shortest and broadest, and has the heavier spine or hook, while the last two segments often lack the hook. The abdomen is finely granulate and at the lower edge of each scutum there are eight heavy, short, simple hairs.

Pedipalps: Longer than body, coxa smooth, trochanter with large protuberance ending in a strong spine on outer side; femur longer than cephalothorax, slightly concave on inner edge, convex on outer edge. Tibia pedicellate, shorter than femur. The trochanter, femur and tibia are all granulate and sparsely covered

Figure 3. Pedipalp of *Chelanops serratus* n. sp. ×50.

with short, simple hairs. Claw large, hand broad, smoothly convex on both sides; finger as long as the hand and slightly curved. It is also provided with long, tactile hairs.

Mandibles: Small for size of animal; fixed finger provided with small teeth. Serrula attached throughout the length of moveable finger. Flagellum divided into small parts. Spinnerets small and transparent.

Legs: First three legs with trochantins, claws simple, legs covered with simple hairs.

Habitat: Sycamore canyons, Laguna Beach, Whittier Hills, Cucamonga canyon, Arrowhead canyon, Lytle Creek canyon, Evey's

canyon, San Antonio canyon, and from oak and sycamore trees around the college campus.

Chelifer scabrisulis Simon

I will not describe the details of this species, because it is so much like the last described, differing from *C. fuscipes* by not having the prolonged hooks like spines, on the outer edges of each abdominal scutum. The color differs from the other two. The abdomen and legs are light brown. The cephalothorax and palps are a little darker yellowish brown.

The habitat of this species was the same as that of *C. fuscipes*. When collecting, they were generally found together.

Chelanops oblongus Say

Description: Length of body, including mandibles, 5 mm; abdomen, 4 mm.; pedipalps, 4.5 mm.; claw, 2mm. Color—Cephalothorax, light reddish brown, pedipalps darker, abdomen yellow with dark brown spots, legs pale yellow.

Cephalothorax: Very short for length of body. Front margin truncate, sides almost straight, lower margin slightly convex, smooth and shiny and provided with many short hairs.

Abdomen: Four times as long as it is wide; sub-parallel sides. Each scutum with a dark spot on each side and each dark spot surrounded by long, simple hairs arranged in a definite order.

Pedipalps: Nearly as long as the body, coxa smooth, trochanter stout and short; femur pedicellate, broadest part being near base, as long as the cephalothorax, inner edge slightly concave, outer edge strongly convex; tibia shorter than femur, pedicellate, strongly convex on inner edge, on outer edge slightly concave near base, but strongly convex beyond.

Claw: Large, finger very stout and curved, shorter than the hand. Hand very broad, very convex on outer edge, only slightly so on inner edge. The trochanter, femur and tibia are covered with stout simple hairs of varying length.

Mandibles: Small and short, serrula attached throughout length of finger, spinnerets small and transparent.

Legs: Short and stout, covered with short, stout, simple hairs.

Habitat: This has been reported from Palm Springs, but one specimen was found within our area at Brown's Flats, at about four thousand feet elevation, in an old pine log.

Chelanops pallipes Banks

Similar to *C. dorsalis,* but fingers longer than hand and very slender; tibia also slender, less convex on the inner side, hard parts with clavate hairs. Three millimeters long. (From Banks.)

Habitat: Los Angeles and vicinity, but has not yet been found in our immediate region.

Chelanops acuminatus Simon

Cephalothorax and palpi reddish brown, with short but not clavate hairs; no eye spots; pedipalps rather short, hand evenly convex on inner side at base, fingers much shorter than the hand and quite stout. 3 mm. long. (From Banks.)

Habitat: Claremont and Los Angeles.

Chelanops lagunae Moles

This species was described in the March number of this Journal, 1914.

It differs chiefly from *C. dorsalis* Banks by having two eye spots. It is a smaller species. This small species was found in Sycamore canyon, near Laguna Beach.

Chelanops paludis Moles

This species was described in the June, 1914, number of this Journal.

The very broad form of the abdomen is characteristic.

This was found on poplar trees and in poplar logs in the Chino swamp.

Chelanops serratus n. sp. Fig. 3

Description: Length—Pedipalps, 3 mm. Impossible to take measurements of other parts, for slide was so poorly made, but the body was small. Color—Cephalothorax and pedipalps, strong yellow brown; legs and abdomen, light yellow.

Cephalothorax: As long as it is broad, sides evenly convex, upper margin straight, one distinct median suture; no eye spots; surface of cephalothorax very granular.

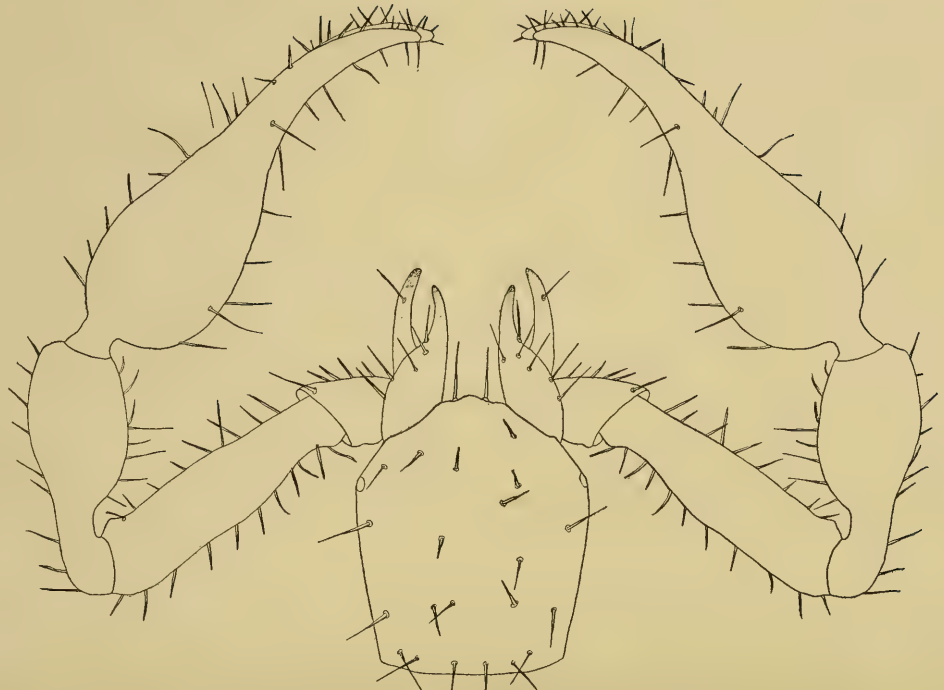


Figure 4. *Ideoroncus obscurus* Banks. Forward part of the animal from above. ×25.

Abdomen: Badly curled up; scuta entirely covered with short almost clavate hairs.

The naming of this species is based on the short "saw-like" hairs that are all over the body. They are not globular on the end, as the clavate hairs, but have "saw-like" edge.

Palps: Short and stout, coxa smooth, trochanter as usual, femur shorter than cephalothorax; pedicellate, inner margin almost straight at base, then suddenly concave to tip, outer margin evenly but not strongly convex; tibia broad, pedicellate, suddenly enlarging on inner side near base, outer margin evenly convex. Trochanter, femur, tibia strongly granulate and sparsely covered with these "saw-like" hairs.

Hand: Broad as it is long, greatly swollen on inner margin near base; fingers slightly curved and as long as the hand.

Mandibles: Small; spinnerets small and transparent; serrula attached throughout the length of the moveable finger.

Legs: The two anterior legs with trochantins; legs covered with many hairs.

This specimen was found on the window pane of the Pomona College greenhouse. A fly (*Musca domestica*) lit on the pane and the pseudoscorpion caught its legs and clung while the fly crawled about. This is the only one of its kind that has been found.

Atemnus hirsutus Banks

Described by Banks in this number of the Journal. Only one specimen of this species was taken. This is the species found nearest the ocean. The broad hand is quite evident. Found ten feet from the ocean, among stones, at Laguna Beach.

Obisium macilentum Simon

Description: Pale yellowish brown, legs paler; hard part shining; cephalothorax one-fourth longer than broad. Sides parallel; mandibles about one-half the length of the cephalothorax; pedipalps very long and slender, with long, fine, scattered hairs. Femur as long as the cephalothorax. Fingers longer than hand.

Habitat: Claremont.

Ideobisium threveneti Simon

Description: Length of animal, including mandibles, 4 mm.; length of palps, 3.5 mm.; length of abdomen, 3 mm.; length of claw, 1.5 mm. Color—Cephalothorax and palps, dark reddish brown; abdomen, lighter than cephalothorax; legs, pale yellow.

Cephalothorax: As long as it is broad, upper margin truncate, sides nearly straight, lower margin straight; no suture; four distinct eye spots; eyes on each side almost touch each other.

Abdomen: Elongate, three times as long as it is broad; scuta entire.

Palps: Coxa smooth; trochanter small; femur long, outer edge almost straight, inner edge slightly convex; tibia short and stout, pedicellate, convex on inner and outer surface.

Claw: Not large; finger as long as hand and not curved very much; hand, broad, evenly convex on inner and outer edges.

Legs: Lack trochantins, III and IV stouter than I and II; mandibles large; serrula not attached throughout length of moveable finger; spinnerets long and transparent.

Habitat: Claremont, Ice House Canyon, under leaves.

Ideoroncus obscurus Banks

Description: Length of animal, including mandibles, 3 mm.; length of pedipalps, 3 mm. Color—Cephalothorax and pedipalps dark yellow brown; abdomen and legs very light yellow.

Cephalothorax: A little longer than broad; front margin slightly truncate, rounded; sides so slightly convex as to be almost straight; lower margin slightly recurved; no transverse sutures; one pair of eyes.

Abdomen: Elongate and slender; scuta entire; both abdomen and cephalothorax with a few simple scattered hairs.

Palps: Long and slender; coxa smooth; trochanter lacks large protuberance of many of the Cheliferidæ; femur hardly as long as cephalothorax, very slender and not pedicellate; tibia shorter and broader than femur, pedicellate, convex on inner edge, only slightly so on outer edge; trochanter, femur, and tibia covered with short, stout simple hairs; claw long and slender; finger little longer than hand, and only slightly curved; hand twice as long as broad; hand

and claw covered with long, simple hairs; mandibles large, serrula attached only at base; spinnerets long and transparent.

Legs: The femur and tibia of the first two pairs of legs rather stout; no trochantins; covered with simple hairs.

Habitat: Found in oak trees in the wash around Claremont.

This differs slightly from that described by Banks in that:

1. The upper margin of the cephalothorax is not rounded, but truncate.
2. The fingers of the claw are not shorter than the hand.
3. The femur and tibia of the first two pairs of legs are not stout.

(Contribution from the Zoological Laboratory of Pomona College)

Some Points in the Nervous System of a Large Deep Water Crab

WILLIAM A. HILTON

During the summer of 1914 several living specimens of the large crab *Loxorhynchus grandis* Stimp. were obtained at Laguna Beach. One of these was kept for some time in a tank of sea water, and its general movements were observed as it walked about on the bottom or attacked the sharks or other fish in the aquarium. Its movements were slow and its senses seemed not very acute in this situation.

A gross and microscopical examination of the nervous system gave much the appearance of these organs in other decapods, but the remarkably small size of the brain or head ganglion was especially noticeable. The nerves connected with this ganglion were long and slender. The optic was large, the tegmental a little smaller and the first antennal about as large as this last. Closely associated with the optic was the small oculomotor, and near the connectives the small second antennal. Other small nerves were connected with the brain, whose courses were not traced, including a pair of small frontal nerves.

The connectives with the thoracic-abdominal ganglion were long and slender, with each its small ganglion a short distance from the brain. A cross connection between these connectives was not seen. It may have been broken in the dissection.

The thoracic-abdominal ganglion has many nerves connected with it, as shown in the figure; the largest of these were traced to the legs and upper thoracic appendages. The legs are large and heavy and the nerve trunks in them are large; their combined bulk would probably be many times that of the ventral ganglion.

So far as studied, the internal arrangement of tracts and cells does not differ materially from the classic descriptions of Bethe in another species. One thing especially noteworthy is the fact that the nerve cells do not seem especially large, nor are the large ones numerous.

The nerve cells and fibers were studied in preparations fixed in Flemming's fluid and stained with iron hematoxylin. As in forms previously studied, the general structure of the ganglion in a way duplicates the structure of the nerve cells, in that a general reticulum forms a framework for the other structures in both. It is hard

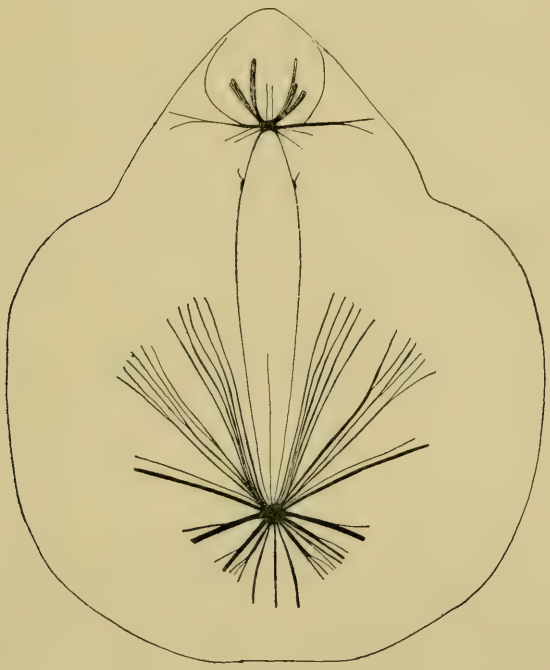
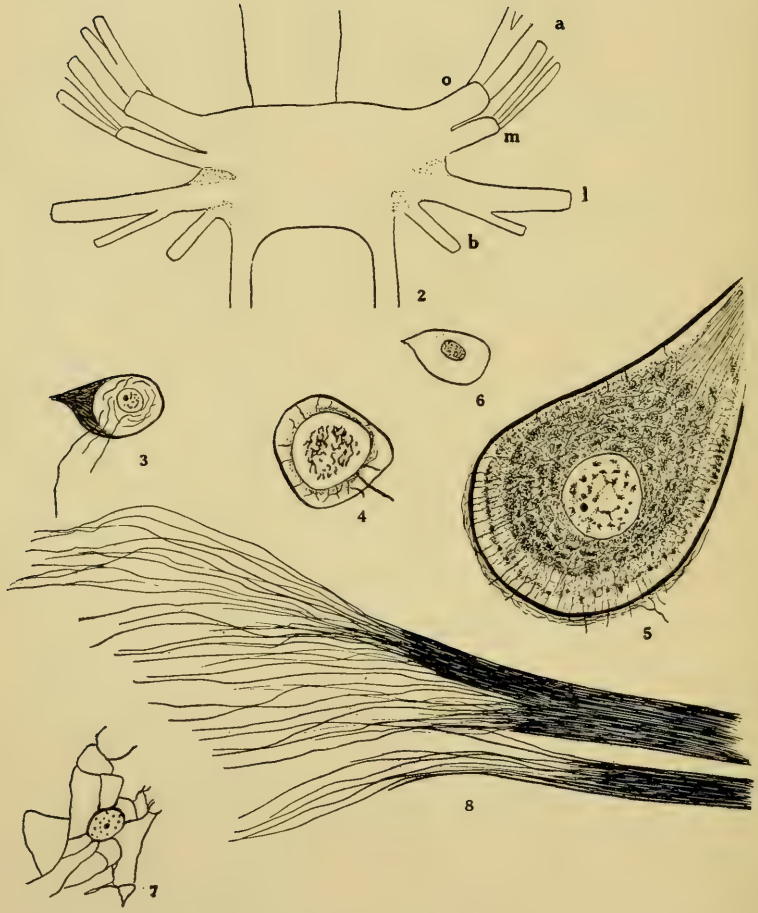


Figure 1

in individual cases to distinguish the supportive structures from the conductive, but the fibers and fibrils in or outside of the nerve cells run in longer straight lines—that is, they do not form so much of a meshwork, although they may branch and intertwine to some degree both within and outside the nerve cells. Large strands or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fibers from nerve cells run as fibers, then divide into smaller masses of fibrils, and at last break up into numerous fibrils. The usual demonstration of nerve cells with their branches as shown by the Golgi or methylene blue methods, I believe, shows only the *larger* and *smaller* branches from nerve cells, and the smallest branches where the fibers break into fibrils are not shown at all.

In this and other arthropods which I have studied, it seems to me to be quite characteristic of the nervous system that many parts show fine fibrillæ more clearly than they are seen in vertebrates. This may in part be due to the nature of the insulating and supportive apparatus. As in *Carcinus,* described by Bethe, the optic tract enters the mesal side of the globulus and splits up into smaller and smaller parts, and is at last lost in the minute network of fibrils and supporting substance. Large bundles from the outside may be seen as dark masses here and there. These last are held in place in the section by many connecting strands which join the fibers from all sides. Some may be conducting fibrils, but it is hard to distinguish these from supportive. Probably most of the conducting fibrils leave at or near the termination of the thicker part of the fiber. The denser parts of the nervous system of this and other arthropods, such, for instance, as the material of the globulus, are composed for the most part of ultimate fibrillae whose relationships at these points can only be conjectured at present because of their minuteness, their great abundance, and because of the intermingling of supportive or other materials of several little understood sorts. An extensive comparative study of these denser masses with various reagents should yield some interesting results.

Tigroid substance, mostly in the form of dots and flakes, was recognized, but not studied by special stains. The cells are surrounded by a dense capsule of connective substance, and in some cases the peripheral zone of the cell next the capsule is light. In some, this light zone is speckled with dark dots or lines. Some of these may be the ends of fibrillæ—in fact, some fibrils were traced —others may be tigroid substance, or possibly the bodies recognized by Poluszynski in some Crustacea, although his are stained by other methods.

PAPERS MENTIONED

Bethe, A. 1898

Das Nervensystem von Carcinus maenas. Arch. f. Mic. Anat. Bd. 51.

Poluszynski, G. 1911

Untersuchungen über den Golgi-Kopsch'schen apparat und einige andere Strukturen in dem Ganglionzellen der Crustaceen. Bull. Acad. Sc. Cracovie.

Figure 1. Outline of the cephalothorax of *Loxorhynchus,* showing the position and size of the nervous system. One-half natural size.

Figure 2. Brain of *Loxorhynchus* from above. ×10. o, Ocular nerve; m, oculomotor; t, tegmental nerve; a, first antennal nerve; b, second antennal; c, connective.

Figure 3. Nerve cell with fibrils from the brain. ×900.

Figures 4 and 5. Nerve cells near each other in the brain fibrils are shown. ×900.

Figure 6. Neuroblast from a doso-median mass of the brain. ×900.

Figure 7. Neuroglia cell with branches from the brain. ×900.

Figure 8. Two fibres breaking into fibrils. From the brain. ×900.

(Contribution from the Zoological Laboratory of Pomona College.)

A New Pseudoscorpion from California

NATHAN BANKS

Professor Hilton recently sent me a pseudoscorpion taken on the beach near water, which proves to belong to the genus *Atemnus*. Our common Florida *Atemnus* also occurs on the sea beach. The Californian species differs from the Florida form in having a larger hand and more hairy body.

Atemnus hirsutus n. sp.

Pale yellowish; cephalothorax a little longer than broad behind, narrowed in front, sides slightly sinuate, clothed with short, simple

bristles; mandibles not one-third the length of the cephalothorax, with a short stylet; abdomen elongate, cylindrical, the segments with apical and preapical rows of simple bristles; legs rather large, with many simple bristles, all showing trochantins. Pedipalpi large, clothed with many fine simple hairs and bristles; the trochanters bituberculate behind near tip; the femur about as long as the width of the cephalothorax, of nearly equal width throughout; the tibia about as long as femur, a little broader beyond the middle, about equally convex on each side; hand extremely broad at base, barely shorter than the tibia; fingers as long as the hand, much curved, each with some tooth-like granules and a fine toothed ridge on the apposed sides.

From Laguna Beach, California, ten feet from the ocean. (Hilton.)

A Nebalia from Laguna Beach

R. LA FOLLETTE

Among the many marine forms collected and studied at Laguna Beach this summer were several Nebalia, which were taken by Mr. Lichti from a hold fast cast up on the beach. A specimen was sent to the National Museum at Washington, where it was classified as *Nebalia bipes* O. Fab. A brief description of the animal will be given in this paper.

Nebalia bipes O. Fab. (Plate I, Fig. 1) belongs to the order Phyllocarida, which is the linking order between the Branchiopoda and Copepoda on one hand and the Schizopoda and Decapoda on the other. There are only three genera, and the commonest of these is *Nebalia*. So far as I know this form has never before been reported from this region. The specimen here described was 9 mm. in length and a whitish flesh color. It was transparent in the living animal. The body is divided into a head, thorax and abdomen, having the normal malacostracan number of segments, except the abdomen, which is made up of eight, the last bearing caudal styles. There is a bivalved cephalic carapace extending back to the fourth abdominal segment and terminating in front in a movable rostrum. The eyes are large, round and raised on movable stalks.

There are two pairs of antennæ (Plate II, Fig. 2), the first pair being four-jointed, the last joint rather broad and armed with many hairs along the outer margin. The other joints have a few hairs on the articulating margin. The flagellum rises from the fourth joint, behind the fifth and has fourteen joints, each one armed with several hairs on the outer margin of the articulation. The second antennæ are slightly larger than the first and made up of three joints with a brush of plume hairs at the caudal end of the second joint. The flagellum is fourteen jointed. The mandible has a two-jointed palp (Fig. 3), with numerous hairs along the outer margin. The second maxilla also has a palp extending back under the carapace with the function of keeping the carapace free from foreign bodies.

The thoracic feet (Fig. 3) are about 1.5 mm. in length, eight in number and biramous. The outer margins are heavily covered with hair, while the inner margins are comparatively smooth. The first four abdominal appendages (Figs. 5, 6) are much larger than the thoracic feet, being 2.5 mm. in length, and are used for swimming, like those of the copepods. They are also biramous, the back margin and tip having numerous hairs along the edge, while the inner margins are lined with many plumous hairs. The first appendage (Fig. 5) is somewhat heavier than the fourth (Fig 6), but the hairs and spines are arranged in the same relative position. The fifth appendage (Fig. 7) is two-jointed uniramous and small, .9 mm. long. The sixth is one jointed and smaller yet.

The eight abdominal segments taper off in size and the last bears a pair of caudal styles (Fig. 8) which are lined with sharp spines along their outer margins. The ends of the styles are armed with two long, sharp spines.

(Contribution from the Zoological Laboratory of Pomona College.)

EXPLANATION OF PLATE I

MAGNIFICATION 25 TIMES

Figure 1. *Nebalia bipes.*

EXPLANATION OF PLATE II

MAGNIFICATION 25 TIMES

Figure 2. Antennæ.
Figure 3. Mandibular palp.
Figure 4. Thoracic appendage.
Figure 5. First abdominal appendage.
Figure 6. Fourth abdominal appendage.
Figure 7. Fifth abdominal appendage.
Figure 8. Caudal styles.

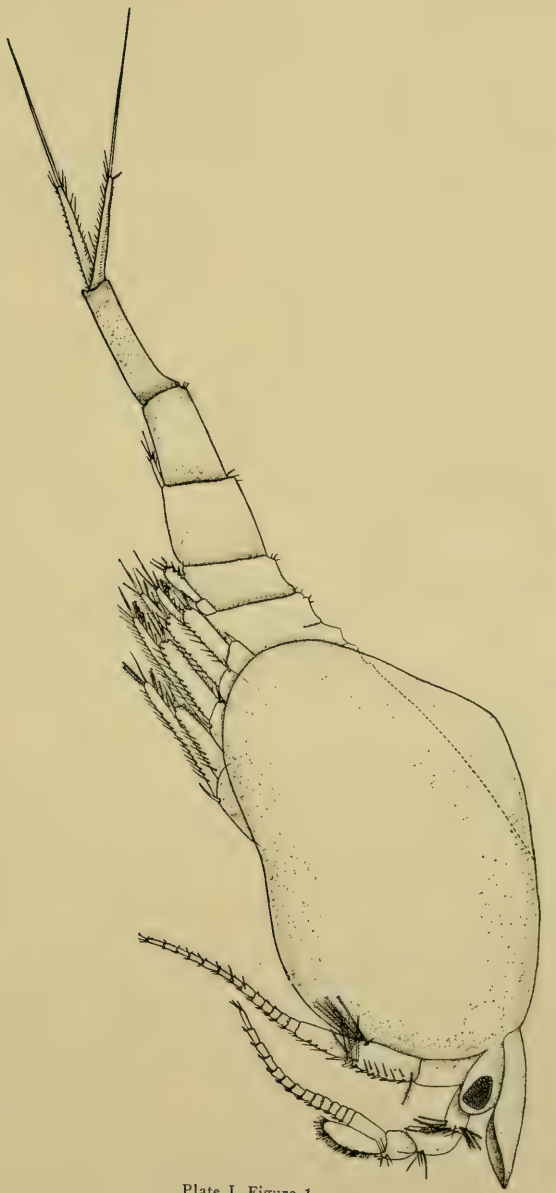
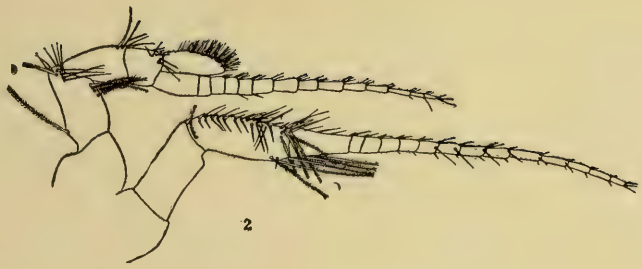


Plate I, Figure 1



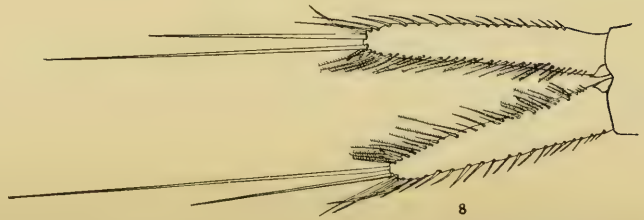


Plate II

Starfish of Laguna Beach

The following is a fairly complete list of shore forms of starfish at Laguna. All but the last one mentioned were photographed by Miss Clency at Laguna Beach.

Linckia columbiae Gray. Fig. 1

A large number of these were collected under stones and in tide pools near shore. A number were found with six arms, and often the arms were very irregularly developed. The power of regeneration is very marked, as may be determined from the appearance of even a small number of individuals.

Orthasterias gonolena Verrill. Fig. 2

This is the "soft starfish." Clark has called it *Asterias forreri.* Fisher (in first Laguna report) called it *A. sertulifera.* Verrill considers it different from either of these last two. We must thank Dr. Clark for this information, as well as for the identification of the remaining species of starfish.

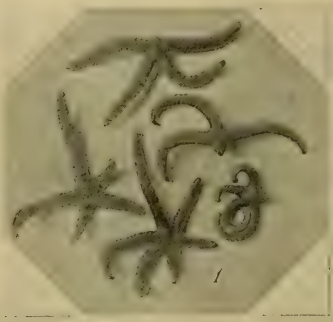
This form is fairly common in the tide pools and under stones not far from shore.

Pisaster capitatus Stimpson. Fig. 3

This is our most beautiful species, but is not as common as the next species with which it is often found. On the points and especially among the mussel beds this species may be found. Its colors during life are beautiful with their delicate shades.

Pisaster ochraceus Brandt. Fig. 4

This is our most common species on the rocky points and among the barnacles and mussels, where they may be found by the dozen. The color variations are quite marked, some being a light red brown, others a darker shade. Some specimens of large size were obtained.



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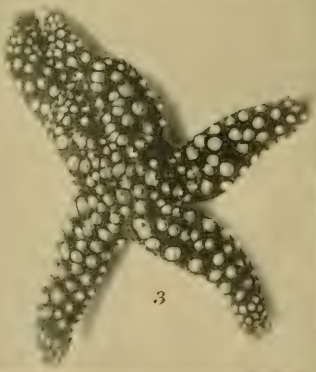

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Astropecten erinaceus Gray. Fig. 5

This beautiful starfish, with its pearl gray shades, is a deeper water form than the others. A few were found in the living condition cast up on the shore, and some were obtained from the fishermen, but they were not often found.

Asterina miniata Brandt. Fig. 6

These broad armed starfish were found quite often in the tide pools near shore; usually of a deep orange color, they were sometimes much lighter than this. W. A. H.

(Contribution from the Zoological Laboratory of Pomona College)

Barnacles of Laguna Beach

MISS S. P. HUGHES
PACIFIC UNIVERSITY, FOREST GROVE, OREGON

Five species of barnacles were found last summer at Laguna Beach. For the identification of the first two of these, we must thank Dr. H. A. Pilsbry of the Academy of Natural Sciences, Philadelphia.

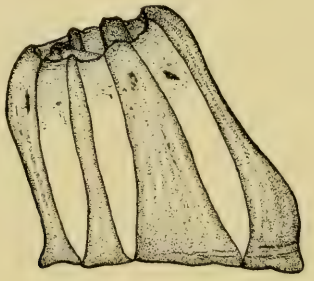

Figure 1

Balanus tintinnabulum californicus Pils. Fig. 1

The most common of the acorn barnacles; found abundantly on rocks, mussels, etc. There are six valves or plates; the rostrum, carina, and two latera on each side. These plates are delicately

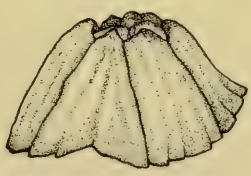

Figure 2

marked with pink stripes. The connecting pieces are often transversely lined. This is the largest of the common acorn barnacles; the average height is about an inch.

Balanus nubilus Darwin. Fig. 2

This is one of the small acorn barnacles, also very numerous on the rocks at tide level. Here the plates, usually six in number, although in some the lateral plates are divided, are closely joined to each other without connecting pieces.

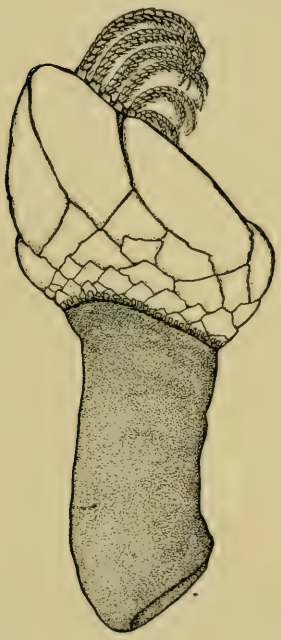

Figure 3

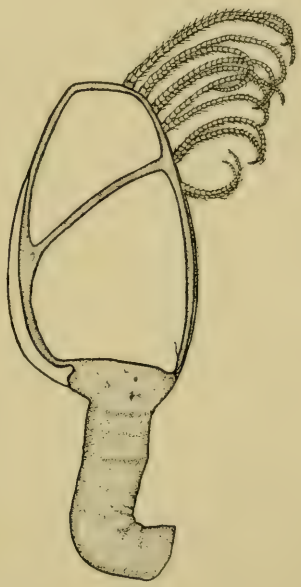

Figure 4

Mitella polymerus Sowerby. Fig. 3

This is a very abundant species, and is found in great masses on the rocks near the tide level. It is readily known by the numerous irregularly arranged scales at the base of the capitulum. The valves are usually much worn, and many cases of regeneration have been noted. The peduncle is covered with fine scales.

Lepas anatifera Linnæus. Fig. 4

This is a fairly abundant goose barnacle, found in hold fasts of kelp and occasionally on driftwood and floating objects. The size varies from a few millimeters to almost an inch in length. The distinguishing characters are the very fine striations on the valves, the presence of an umbonal tooth on the right scutum, and the proximity of the base of the carina to the scutum. The valves are a delicate pale blue color and the peduncle a deep purplish brown.

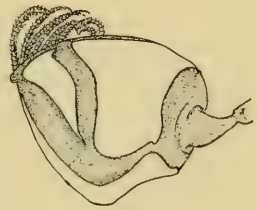

Figure 5

Lepas fasciculatus Elis and Solander. Fig. 5

Two specimens were found by Mr. Lichti upon the beach at Green Bay, Laguna Beach, in September of this year. Others have been collected from the Laguna region.

It is a light pelagic form, with paper-like plates and angularly bent carina, with a prominent umbo.

Notes on the Eggs of Some Laguna Beach Invertebrates

P. A. LICHTI

During the past summer a large number of species and individuals were examined for eggs. Some of these fragmentary notes may be of use to others who may carry the study further.

The serpent stars were not especially studied for the eggs, but during July several hundred were collected from various places. These were mostly of one species. About one-third of these contained well developed ova. On July 14th and 20th, six individuals of the genus *Ophiothrix* deposited eggs in the aquarium jars. During August three out of twenty specimens had ova well developed, many may have been young.

Comparatively few female sea urchins were found. Out of 50 individuals opened, 36 were males, six females, and the rest young. Miss Wang also found that the males were more numerous than the females as they were collected, four to one. Miss Wang was able to keep the sperm alive for 96 hours in the laboratory before we had running salt water.

In the common shore goose neck barnacle *Mitella,* ova and segmentation stages were found during the summer.

The common rock crab, *Pachygrapsus,* was examined many times during July and very few adult females were without eggs. During the same day mature ova and advanced embryos were found. August 10th, about half the females were without eggs. On September 4th, about two-thirds were without eggs. The early summer seems the more active spawning season.

A live female deeper sea crab, *Loporhynchus,* was caught on June 25th. The enormous mass of eggs was unsegmented and failed to segment in the laboratory, although the animal was kept alive for some time. On July 20th, another female was caught, the embryos were well advanced and it was possible to see the heart beat under the microscope. They lived only a few hours.

The sand crabs of the genus *Eremita* were found laying their eggs all summer. Some hundreds were examined, and it was found that up to September egg masses were nearly always found with the females. In the whole season, out of 236 examined, only 11 in September were without eggs. It was found that while the eggs on the swimmeretts were developing into crabs another egg mass was being formed in the ovaries, this last reached maturity about the same time that the young crabs on the swimmeretts hatch.

A species of *Cypris* was found in a pool about 1½ miles up Laguna canyon. These had many eggs on July 1; by July 17 no eggs were found.

A number of species of isopods and amphipods were found to have eggs during the summer, and during September it was very easy to obtain *Ligyda* with eggs or young, although the proportion of young stages was becoming less.

Members of the genus *Caprella* were found with eggs at different times during the summer and up into the fall.

Of the pycnogonids, the following genera were found with eggs during the summer: *Lecythorhynchus, Ammothella* of two species; *Halosoma, Pycnogonium, Palene, Tanystylum* of two species.

A number of chitons were examined, but with negative results. Probably many were young.

Some of the bivalved forms were examined, but the character of the period of reproduction is not yet determined.

The sea hare, *Aplysia,* laid its eggs in the aquarium jars during the middle and late summer.

Many of the species of nudibranchs collected during the summer were found to deposit eggs in the laboratory. One species, a light brown form, was found abundantly in kelp hold fasts. They laid coiled ribbon-like masses of eggs.

Eight different individuals of the genus *Doris* deposited eggs in the laboratory.

On July 28, two of the genus *Hermissenda* and one *Spurilla* (?) deposited eggs.

Laila and several unknown forms deposited eggs in the laboratory during the first part of September.

(Contribution from the Zoological Laboratory of Pomona College)

Preliminary Notes on Some Marine Worms Taken at Laguna Beach

W. F. HAMILTON

During the summer of 1914 I made a collection of some 230 bottles of annelids. It was thought best that I should publish a list of the families and of such species as I have succeeded in identifying.

POLYCHAETA

SYLLIDÆ

Are quite abundant among the finer sea mosses.

Pionosyllis elongata Johnson.

Found among goose-neck barnacles west of the Laboratory and in sea weed tangles. White with bright red eggs coloring posterior end. Taken June 26, 1914.

Two other forms are common in the finer sea moss.

POLYNOIDÆ

Are of frequent occurrence on rocks and in seaweed tangles. I have identified four species.

Halosydna insignis Baird.

The most common and variable polynoid at Laguna. Color of elytra yellowish gray to bright red. Length from 18 to as much as 47 mm. (contracted).

Halosydna californica Johnson.

Less abundant. Similar in distribution. More slender and of a lighter pigmentation.

Lepidasthenia gigas Johnson.

This interesting form was taken from a large mass of the tubes of *Vermetus (squamigerus?)* (gasteropod). Heretofore, as far as I know, it has only been recorded as a tube commensal with a large *Amphitrite*. My specimen was not commensal, but was hidden among the mollusc tubes. The color was recorded as a "light, unsaturated yellow, elytra darker yellow, body irridescent below. The setae project only their tips beyond the parapodia, differing only in this respect from

Johnson's figures. I could not find any asymetrical somites, judging from the elytrophores. The elytra were all gone and the specimen was poorly preserved.

Harmothoe hirsuta Johnson.

A single specimen 25 mm. long, badly mutilated and in a poor state of preservation was taken in seaweed between tide-marks. Two other species were taken from a similar location, but I have not identified them yet.

PHYLLODOCIDÆ

Three unidentified kinds inhabiting seaweed tangles and holdfasts are in the collection.

EUPHROSYNIDÆ

Euphrosyne aurantiaca Johnson.

NEREIDÆ

Are common in the atokous state, and one "heteronereid" was brought in from an unknown location.

Nereis agassizi Ehlers.

Specimens which agree closely with figures by Johnson are found very abundantly in seaweed tangles.

Nereis virens Sars.

A single specimen was taken in wave-washed sand three miles south of the Laboratory.

There is another species, resembling *Nereis procera* which I have not yet identified.

Two specimens of this beautifully brilliant orange annelid were taken on holdfasts.

EUNICIDÆ

I found few of these, but such as I did find were in burrows in a soft shale ledge or in sand under large stones.

LUMBRICONEREIDÆ

Lumbriconereis erecta (?) Moore.

I am not sure of this determination. The setae are identical, but the parapodia are not quite the same as those figured by Moore. The worm is very abundant in the sand under large stones. One or two similar species are common in seaweed and under mussels.

GLYCERIDÆ

Two species of this family were found in the sand under large stones.

Hemipodia borealis Johnson.

Found under a large rock, buried in the sand. One very large and active glycerid was found in the same locality. I have not identified it.

CIRRATULIDÆ

Found in the roots of eel-grass, in holes in a soft shale ledge or in the sand under large stones.

Cirratulus robustus Johnson.

Cirratulus spirabranchus Moore.

Found in abundance in the above places.

TERREBELLIDÆ

Found with the *Cirratulidae.*

Schmardanella californica Moore.

Is very abundant in the matted roots of "eel grass."

Two other forms are quite abundant wherever *Cirratulus* is found.

MALDANIDÆ

Found on holdfasts.

Clymenella rubrocincta Johnson.

Fairly common.

CHLORHÆMIDÆ

I have a half dozen of these from holdfasts.

SABELLIDÆ

Small sabellids are common in holdfasts and seaweed masses.

SERPULIDÆ

The calcareous tubes of these animals are seen everywhere below half tide, on rocks, in holdfasts and on kelp (spirobis). I have six different serpulids.

HERMELLIDÆ

There are probably two species of this family common at Laguna.

Sabellaria californica Fewkes.

This form was found in large colonies in the protected crevasses of cliffs west of the laboratory. The colonies are some twenty feet long, two feet wide and ten inches thick. The tubes are of loosely agglutinated sand and are crowded very closely together with their mouths evenly disposed over the surface of the colony.

Another species lives singly in very hard, thick sand tubes. Some specimens have algæ growing on their opercula.

Turbellaria

I have three kinds of these "flat worms" in my collection. They are found under partly submerged stones.

Nemertinea

There are seven different nemertines in the collection. They are recorded from holdfasts, seaweed tangles and from among vermetus tubes.

Nematoda

There are two or three different marine nematodes in the collection. They are most common in the finer moss.

Sipunculoidea

There are two kinds of sipunculids, which seem quite distinct. Taken from eel grass roots, from under rocks and mussels.

The specimens were identified from the following papers:

Fewkes, J. W. 1899

New Invertebrata from the Coast of California. Bull. Essex inst. xxi, 99-146, pls. 1-7 (2) figs. in text.

Johnson, H. P. 1897

A Preliminary Account of the Marine Annelids of the Pacific Coast, with Descriptions of New Species. Proc. Cal. ac. sc. (3), i, 153-198, pls. 5-10.

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The Polychætæ of the Puget Sound Region. Proc. Bost. soc. nat. hist., xxix, 381-437, pls. 1-19.

Moore, J. P. 1904

New Polychætæ from California. Proc. acad. nat. sci., Philadelphia, 56-484-503, pls. 37-38.

(*Contribution from the Zoological Laboratory of Pomona College.*)

Studies in the Comparative Size of the Red Blood Corpuscles of Birds

CHI TSAU WANG

The blood corpuscles of a large number of vertebrates were studied at Laguna Beach during the past summer. Some of the sizes of cell and nucleus are given below. The blood was obtained as fresh as possible; in no case was the blood obtained longer than twenty-four hours after death. The corpuscles were measured by the ocular micrometer and checked by the aid of a camera lucida.

Common Name	Scientific Name	Average Size of Corpuscle Microns		Average Size of Nucleus Microns	
		Length	Breadth	Length	Breadth
Western Gull	Larus occidentalis	14.70	8.82	6.53	3.27
Heermann Gull	Larus heermanni	14.05	7.84	6.21	2.77
Great Blue Heron	Ardea herodias	13.72	8.82	6.53	3.27
Red-breasted Merganser	Mergus serrator	13.07	7.51	6.86	2.77
Arkansas Kingbird	Tyrannus verticalis	12.77	9.47	5.55	3.10
California Road Runner	Geococcyx californianus	12.09	9.15	5.27	3.27
Long-billed Dowitcher	Macrorhamphus griseus scolopaceus	12.41	8.49	5.24	2.46
Least Tern	Sterna antillarum	11.76	8.46	6.21	2.94
Semipalmated Plover	Aegialitis semipalmata	11.43	6.21	5.24	2.77
Arizona Hooded Oriole	Icterus cucullatus nelsoni	11.27	8.49	4.41	2.94
San Diego Song Sparrow	Melospiza melodia cooperi	10.94	8.33	5.27	2.53
Least Vireo	Vireo pusillus pusillus	10.45	9.47	5.55	2.77
California Woodpecker	Melanerpes formicivorus bairdi	10.45	6.53	5.24	2.77
Belding Marsh Sparrow	Passerculus beldingi	10.08	6.86	4.90	2.77
Willow Gold Finch	Astragalinus tristis salicamans	9.80	6.79	6.04	2.94
California Horned Lark	Otocoris alpestris actia	9.47	6.21	4.25	2.12
Western Lark Sparrow	Chondestes grammacus strigatus	8.49	5.55	5.24	3.10

(Contribution from the Zoological Laboratory of Pomona College.)

Caprellidæ from Laguna Beach

R. LA FOLLETTE

This paper is a preliminary article on the Caprellidæ of Laguna Beach, and deals with species that have so far been identified. Because of great variation, due to age, it is very difficult to place the different forms.

Caprella geometrica Say

Mayer places *C. geometrica* as one of eighteen or twenty varieties of the species *acutifrons,* but I have thought it best to follow some of the other writers and use *geometrica* as the species name, as my specimen closely resembles the species which seems to be *C. geometrica* in several accounts.

The specimen here described is an adult male. The peræon (Plate I, Fig. 1) is robust and covered with many blunt tubercles. In this respect it varies from the specimens described by others who say the peræon is smooth. The young are comparatively smooth and develop tubercles on the caudal segments first. Cephalon furnished with a sharp anteriorly directed dorsal tooth. First segment shorter than the second, which is triangular in shape; third and fourth broad and a little shorter than the second; fifth, sixth and seventh each growing smaller respectively and truncate at the tip. Antennæ, stout; superior pair not half as long as the body, first joint short and twice as thick as the second but only half as long, third joint shorter than first; flagellum as long as the peduncle and composed of 15 or 16 joints, inferior pair extending to about the middle of the flagellum of the superior, joints long and narrow.

First gnathopod (Fig. 2), attached far forward, convex in shape and tapering slightly toward the finger, which was long as the palm and narrow; palm armed with tooth-like spine at the base and many hairs. Second gnathopod (Fig. 3), attached just posterior to the middle of the second pereiod, basal joint short and thick, not half as long as the palm; inner margin of the hand concave, armed with a tooth on the dorsal lobe and a broad, truncate tooth near the base of the finger, as well as numerous hairs; finger sharply con-

cave on the inner margin for about half its length. Branchia nearly round. Third, fourth and fifth peræopods (Fig. 4) similar in structure, short, stout, and armed with stiff hairs; hand nearly as long as rest of the extremity; palm broad and armed with numerous hairs, inner margin slightly concave, with two serrate teeth at the base.

Length of specimen, 13 mm.

Color varying from a bright red to white.

Several specimens taken at Laguna Beach the latter part of July, from the Rhodophyceæ on the rocks.

The young of this species were very abundant at Laguna Beach, and I will give a short description of one because of the great variation from the adult. Plate II shows a young male with the antennæ inverted showing the setæ on the ventral side. The first five segments are of nearly equal length; peræon smooth; superior antennæ nearly half as long as the body, with inferior nearly as long as superior; flagellum with six to nine joints. Maxillipeds (Plate III, Fig. 5) with inner plate reaching apex of first joint of palp, armed with two teeth and spines; outer plate reaching apex of second joint of palp and armed with three small teeth. Upper lip (Fig. 6) bilobed, finely ciliated. First maxillæ (Fig. 7) two-jointed, palp and second joint armed with spines. Second maxillæ (Fig. 8) armed with a few hairs on the tip. Mandible (Fig. 9) has cutting plate made of five strong, unequal teeth; teeth of secondary plate nearly equal. First gnathopod attached far forward, triangular in shape and fringed with hairs. Second gnathopod (Fig. 11) attached the same as in adult, palm convex on inner margin, instead of concave as in adult, and armed with two small teeth near inner margin at the base; finger is concave and uniform in outline.

Caprella septentrionalis Kroyer

The specimen here described differs slightly from those described by Mayer, Holmes, Sars and others, yet I do not think the differences great enough to demand the naming of a new species.

The peræon (Plate IV, Fig. 12) is comparatively smooth, first two segments long, as long as the rest of the body; cephalon angularly produced in front into a very short, blunt spine. Figure 13

shows a specimen with a body somewhat broader. The superior antennæ are about half as long as the body, first joint broader than second, but shorter; second joint longest of all; third longer than first, and narrower than second; flagellum shorter than the peduncle and made up of about twelve joints. Inferior antennæ slightly shorter than the peduncle of the superior. Mandible (Fig. 14) cutting edge denticulate, with five irregular teeth, spine row having three large, feathery spines; molar tubercle strong and prominent. First gnathopod attached far forward, against the maxillipeds; hand triangular, fringed with hairs on the inner margin and one spine tooth near the base. Second gnathopod (Figs. 15, 16) attached near the posterior extremity of the second pereiod, basal joint nearly as long as the hand, inner margin of hand lying in a straight line and armed with two teeth near the base of the palm, one on the lobe and the other to one side. Another long tooth is near the base of the finger and is separated from a large, broad tooth by a deep suture; inner margin of the finger irregular. Third, fourth and fifth peræopods are similar in structure and not as stout as those of *C. geometrica;* hands powerful and armed with three clumps of spines on small prominences; differing in this respect from those described by Mayer, Sars and others in that they lack the pair of serrated spines at the base of the palm. Finger stout and half as long as the palm.

Length of specimen, 12 mm.

Color white or flesh color.

The specimens were collected during the latter part of July at Laguna Beach, from the seaweed in the inner tide pools.

Caprella æquilibra Say

The peræon (Plate IV, Fig. 12) is comparatively smooth, with the cephalon devoid of a horizontal spine; the first three segments are long and narrow, of nearly equal length, the fourth a little longer than the third, the fifth twice as long as the sixth and seventh combined. The branchia are ovate in shape and moderate in size. Between the bases of the second gnathopods is a sharp projection (Fig. 13), and on each side another spiniform process pointing anteriorly. Superior antennæ slightly over half as long as

the body, first joint about half as long as the second, but broader; second twice as long as the first, and third a little longer than the first, but narrower; flagellum with sixteen or seventeen joints and about as long as the peduncle. Inferior antennæ reaching just beyond the peduncle of the superior. First gnathopod small, attached far forward, palm triangular in shape, tapering toward the finger, which reaches back entirely over the inner margin of the palm, armed with two sharp spine-like teeth at the base of the palm, and scattered hairs. Second gnathopod (Fig. 14), attached at the posterior end of the segment, basal joint quite short; other joints have their lobes ending in spine-like processes; palm slightly convex on the inner margin, with a spined lobe about a third of the way along, and a blunt tooth two-thirds of the way along separated from a broad tooth by a deep sinus; claw regularly concave; whole gnathopod with but few hairs. Third, fourth and fifth peræopods (Fig. 15) similar in size and structure; palm thick, with two serrate teeth a third of the distance from the base.

Length of specimen, 12 mm.

Color a dark brown to flesh color.

Two specimens taken on a holdfast that was thrown up on the beach at Laguna Beach during July, 1914.

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(Contribution from the Zoological Laboratory of Pomona College)

EXPLANATION OF PLATES

PLATE I

C. geometrica (adult). ×25

Figure 1. Body showing length of segments.
Figure 2. First gnathopod.
Figure 3. Second gnathopod.
Figure 4. Fifth peræopod.

PLATE II.

C. geometrica (young male). ×40

PLATE III

C. geometrica (young male)

Figure 5. Maxillipeds. ×300.
Figure 6. Lip. ×300.
Figure 7. First maxillæ. ×300.
Figure 8. Second maxillæ. ×300.
Figure 9. Mandible. ×300.
Figure 10. First gnathopod. ×175.
Figure 11. Second gnathopod. ×175.

PLATE IV

C. septentrionalis

Figures 12, 13. Bodies, showing length of segments. ×25.
Figure 14. Mandible. ×110.
Figures 15, 16. Second gnathopods. ×25.

PLATE V

C. æquilibra Say

Figure 12. Body showing length of segments. ×50.
Figure 13. Projection at base of second gnathopod. ×150.
Figure 14. Second gnathopod. ×150.
Figure 15. Fifth peræopod. ×150.

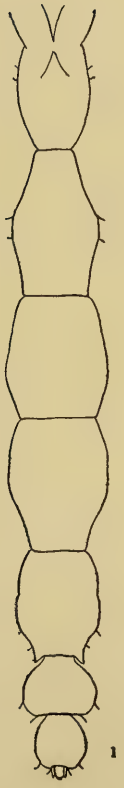
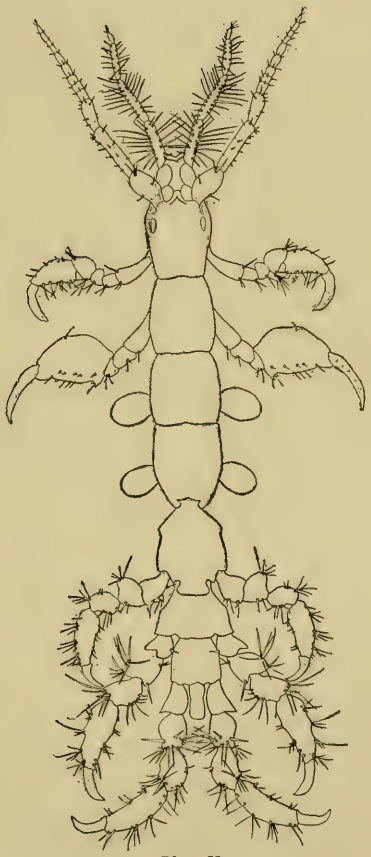


Plate I



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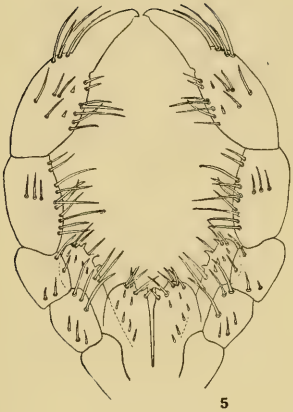

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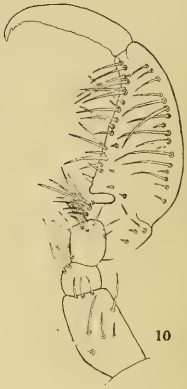

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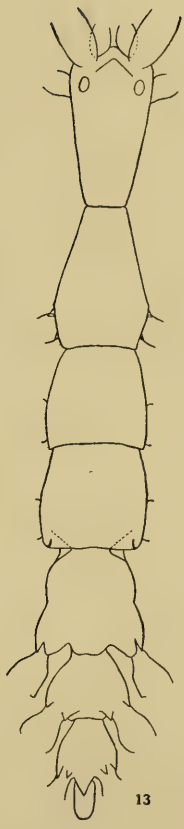
Plate III

15



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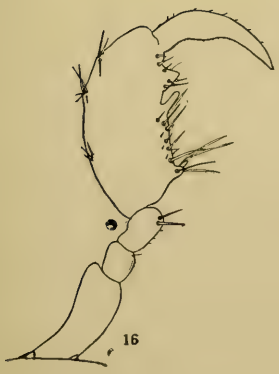

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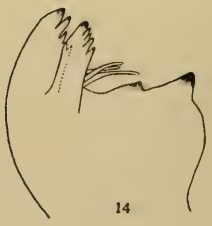

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Plate IV

Plate V

Record of Two Fish, Not Before Mentioned, from Laguna

During the summer of 1914 no special effort was made to collect fish, but the two following species were taken:

Porichthys notatus Girard

A specimen of this interesting but rather common Californian fish was taken in a tide pool and kept for some time alive in the aquarium. This is sometimes called "Midshipman," because of the bright metallic spots over the head and body, like the buttons on a midshipman's uniform of years ago. These spots are provided with a lens, connective tissue capsule and a reflector, and are supposed to be luminous.

Mola mola Linnæus

A small specimen of this head-fish, or sunfish, was brought to us by the fisherman. W. A. H.

Note on the Sea Urchins of Laguna Beach

Due to the kindness of Dr. H. L. Clark of Harvard, we are able now to have some clearer idea about the number of species of sea urchins found at Laguna.

Strongylocentrotus purpuratus Stimp

This is our most common species. It occurs by the hundreds in some of the larger tide pools, such as those near Seal Rocks. Judging from the specimens sent to Dr. Clark, the rather common greenish form, which we supposed to be distinct at first, is simply a younger form of the same species. This greenish form is more often found nearer shore under stones, where quite small individuals are abundant.

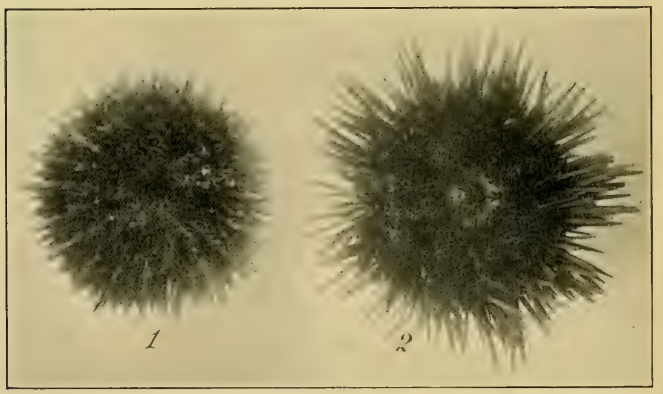

Figure 1. *Strongylocentrotus purpuratus* Stimp. Photo by Miss Clency.
Figure 2. *Strongylocentrotus franciscanus* A. Agassiz. Photo by Hamilton.

S. franciscanus A. Agassiz

These larger urchins are not so common as they may have been. Larger specimens may be obtained under rock ledges in deep water. Smaller forms of the same species, which seem to have long reddish spines, may be found in the tide pools, but are not common.

W. A. H.

Additional Notes on the Birds of Laguna Beach

LEON L. GARDNER

In accordance with the general plan of the Laguna Marine Laboratory, a part of the work was with the birds of the locality.

As mentioned in the First Annual Report of the Laboratory, Laguna Lakes, about four miles up Laguna Canyon; Balboa, eight miles up the coast, and the surrounding rocky wild hills of Laguna, afford rich and varied collecting. Perhaps the richest area of bird life lies between Laguna and Balboa, in the Irvine Ranch. This is a large tract of land comprising many thousands of acres, extending about seven miles up the coast from Laguna and eleven miles inland. The canyons here are steep and, in some localities, very wooded in contrast to the more open canyons farther down the coast. For years this land has been given over to cattle grazing, and the Irvine company, in order to safeguard the stock, have allowed no one, except their own range riders, to enter the property. In the years 1911 and 1912 this was a state game preserve, and there is considerable rumor among local residents that it was stocked with some kind of pheasants. However, I have neither seen nor heard of a specimen taken. In all events, the protection afforded the birds has been taken advantage of, and quail, road-runners, many species of hawks and all of the smaller birds thrive in abundance and safety.

The fifteen days of collecting were spent largely in covering as large an area as possible, to obtain the widest range of representative species, with field notes, etc., to be placed in the Laboratory building, as a nucleus for greater collections and for the benefit of the local residents or summer visitors who are interested in the work of the College.

The additions to the first list, published in the First Annual Report, as mentioned before, are as follows:

Gavia immer (Brünnich) Common Loon

A specimen taken in Balboa Bay, July 6, 1914. This is rather an unusual record, as the Loon is only a winter visitant; however,

some are known to remain throughout the summer. Mr. Swarth tells me that this specimen had lost the power of flight during its molt. He thinks this seems to indicate that Loons lose the ability to fly during molting, as do the Anseres.

Gavia pacifica (Lawrence.) Pacific Loon

June 27, I found a dead Pacific Loon cast up on the beach. The specimen was in very worn and oddly colored plumage. On examination Mr. Swarth said it was a partial albino and had skipped a regular molt.

Larus heermanni Cassin. Heermann Gull

Abundant about the Bay at Balboa.

Mergus serrator Linn. Red-breasted Merganser

A female taken July 6, 1914. This is a very late record for this bird, since it leaves mostly in April. It was found resting on a sand spit in Balboa Bay.

Oidemia perspicillata (Linn.) Surf Scoter

Common along the coast from Laguna to Balboa.

Oidemia deglandi Bonaparte. White-winged Scoter

Occurring with the preceding species.

Erismatura jamaicensis (Gmelin). Ruddy Duck

Occurring at the tule lake in Laguna Canyon.

Himantopus mexicanus (Müller). Black-necked Stilt

One taken at Laguna Lakes, now mounted and in possession of J. N. Isch, Laguna Beach.

Macrorhamphus griseus scolopaceus (Say)
Long-billed Dowitcher

A specimen taken on the sand spits in Balboa Bay, July 6, 1914. This appears to be an early fall migration record.

Catoptrophorus semipalmatus inornatus (Brewster)
Western Willet.

Abundant in August, less common in July. Often in company with Hudsonian curlews (*Numenius hudsonicus*) along the coast. One taken as early as July 6.

Heteractitis incanus (Gmelin). Wandering Tattler

Found in August along the rocky coast by Arch Beach (down the coast from Laguna).

Actitis macularius (Linn). Spotted Sandpiper

Common along the beach in August.

Ægialitis semipalmata (Bonaparte). Semipalmated Plover

A small flock found at Balboa July 13.

Ægialitis novisa Cassin. Snowy Plover

One taken between Laguna and Balboa.

Buteo borealis calurus Cassin. Western Red-tail

Fairly common in the hills. There seemed to be several different species of hawks at Laguna, but as they were very shy and most of them took refuge in the forbidden territory of the Irvine Ranch, none of the larger ones were obtained.

Haliaeetus leucocephalus leucocephalus (Linn.) Bald Eagle.

There are five Bald Eagles that are commonly seen along the beach near Laguna. When followed, they are always found to come to rest on the high, rocky west slope of Aliso Canyon (down the coast from Laguna). The owner of the canyon, Mr. Joe Thurston, tells me that for years a pair has bred there, and these other three are young that did not leave the vicinity. He is very jealous of their safety, and it is to be hoped they may always be kept there as a natural attraction. This is one of the few breeding points along the coast from which the Bald Eagle has not been driven. In March, 1895, Mr. E. Davis took two fresh eggs of the Bald Eagle near Laguna Beach. It would be very interesting to know whether or not he obtained them from the same canyon; if so, this must be a very old breeding place.

Pandion haliaëtus carolinensis (Gmelin). Osprey

One shot from a flagstaff in the center of town. The date is uncertain, but appears to be about 1905. The specimen is now mounted and in the possession of Mr. J. N. Isch of Laguna.

Otus asio bendirei (Brewster). California Screech Owl

Fairly common in the timbered canyons.

Speotyto cunicularia hypogaea (Bonaparte). Burrowing Owl

Common in upper Aliso Canyon, which is more open and very hot and arid.

Ceryle alcyon (Linn.) Belted Kingfisher

I noted two birds which were undoubtedly of this species along a rocky stretch of the coast, but was unable to collect one.

Melanerpes formicivorus bairdi Ridgway. California Woodpecker

I obtained two specimens of this species from a flock in Nigger Canyon. This seems to be a very low altitude at which to find these birds.

Myiochanes richardsoni richardsoni (Swainson).
Western Wood Pewee

I collected two of this species in the willow bottoms July 25, 1912, which seems to be an indication that they are summer residents.

Corvus corax sinuatus Wagler. Raven

Irregular along the coast. One collected July 19.

Astraglinus tristis salicamans (Grinnell). Willow Goldfinch

Common in the willow bottoms.

Ammodramus savannarum bimaculatus Swainson
Western Grasshopper Sparrow

Very common in one particular grassy glade at the top of the ridge around Laguna, also at the tule lakes. I took a young bird June 27, which seems to indicate the birds were breeding there. This is one of the few breeding records for Southern California.

Hirundo erythrogastra Boddaert. Barn Swallow

Common along the rocky cliffs; some breeding in July.

This concludes the additional list. There is one other breeding record worthy of note. In Nigger Canyon (Irvine Ranch) there is a Great Blue Heron nesting colony. Although such colonies were at one time common along the coast, they are now becoming rare. The colony is situated in a large clump of sycamore trees, in the bottom of the canyon, some half mile or more inland. There are about thirty nests, quite white with bird lime; the trees and ground also are well covered, showing the permanency of the site. On June 26, 1914, I visited the colony and found very young birds, but

no eggs. The whole place was filled with a peculiar stench, while the croakings of the old birds, coupled with the frightened squawks of the young, and the invisible, choking powder down, made the place quite undesirable. The old birds were very bold, but not pugnacious, and while the examination of the nests went on retired to nearby trees to watch the proceedings, while the young crowded out to the uttermost branches, keeping up a continual racket.

Owing to the protection afforded by the Irvine ranch, the colony has thrived and probably will for an indefinite period.

(Contribution from the Zoological Laboratory of Pomona College.)

A New Dipterous Gall on Stanleya

T. D. A. COCKERELL

On June 18, 1914, my wife and I found a hitherto undescribed gall on *Stanleya glauca* Rydberg, a remarkable cruciferous plant growing about four miles north of Boulder, Colorado. Thinking

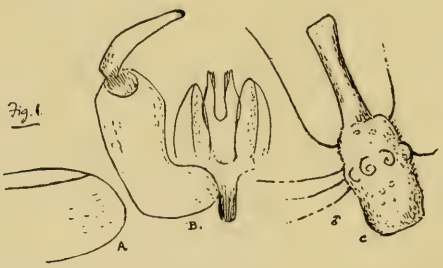

Figure 1. A, Apical part of wing. B, Male genitalia. C, Segment of male antenna.

to rear the adults, the galls were placed in a bottle with some earth and watched for a long time, but nothing appeared. Supposing the effort to have been unsuccessful, I set the bottle aside; but long after

Figure 2. A, Breastbone of larva. B, Spines at caudal end of larva. C, Skin of larva. D, Gall.

discovered that adults had eventually emerged, but had died and were covered with mold. I was able to rescue sufficient fragments to make the drawings given herewith, which, together with the

larval characters, serve very well to indicate the genus, with enough of the specific characters for ready recognition. The species may be called

Perrisia stanleyae n. sp. (Cecidomyiidæ)

Gall: A swollen flower of *Stanleya glauca,* containing many pallid larvæ. The sepals are thickened and enlarged.

Larva: With the skin strongly verrucose; breastbone of the same general type as that of *P. fructicola* Kieffer; caudal end with strong spines.

Male: The characteristic genitalia and antennal joint are figured.

Hydroids of Laguna Beach

PROF. A. M. BEAN
PACIFIC UNIVERSITY, FOREST GROVE, OREGON

The identification of the hydroids included in this list was undertaken while making a general collection of the marine forms of the Laguna Beach region. The specimens were taken mostly from the miscellaneous shore collections, and there is no claim to exhaustiveness. They were, however, examined as fresh material, and nearly always with the living polyp still present. There was abundant promise of opportunity for the study of ecological and developmental problems, of which I was unable at that time to take advantage.

The region covered included a strip of shore line of about two miles in extent. Part of this is sandy beach which after a heavy tide would often be covered by the laminæ and holdfasts of *Macrocystis* and other kelps, to which hydroids were generally attached. The remainder of the shore was rocky and of a remarkably varied conformation, including tidepools, deep channels, rock tables, mussel beds, and short stretches of sand and pebbly beach. Scarcely any attempt was made at dredging, and the shore itself was by no means completely searched.

GYMNOBLASTEA

Family PENNARIIDÆ

Tubularia sp.

This single representative of the Gymnoblastea more nearly corresponds to the *T. marina* described by Torrey, '02. It is, however, much smaller, the erect branches being scarcely ever as much as 15 mm. in length, instead of 30-50 mm. The proximal tentacles are 28 and 29 in number, instead of 22-26, described for *T. marina.* There is very little appearance of annulation of the stem, and no evidence of the "stem increasing in diameter distally." The habitat is also different. *T. marina* is given as growing "between tides on the lee side of rocks exposed to the breakers of the open sea." The tubularian in question, however, was found only clustered in

among the rootlike holdfasts of the *Macrocystis* at a depth of four to six fathoms. Moreover *T. marina* is not reported as occurring farther south than Pacific Grove. There seems to be some reason for considering this a new species, but further investigation, and perhaps a study of comparative material, will be necessary to determine its systematic position.

CALYPTOBLASTEA

Family SERTULARIIDÆ

Sertularella tricuspidata (Alder)

Sertularia furcata (Trask)

Both of the above forms were found on the washed-up holdfasts of *Macrocystis*.

Family PLUMULARIIDÆ

Aglaophenia inconspicua (Torrey '02)

Torrey's description gives "hydrocladia 3-4 mm. long." Out of a large number examined, however, I found none with hydrocladia more than 1.5 mm.

Aglaophenia struthionides (Murray)

Both *A. inconspicua* and *A. struthionides* were taken from the red algæ brought in by the tides.

Plumularia setacea (Ellis)

This form appears to have a wide variation in its bathymetric distribution. Specimens were collected from the mussels which are uncovered at mid-tide, and from the carapace of *Loxorhynchus grandis*, a deep-sea crab that is only rarely brought to shore by the highest tides.

Plumularia lagenifera (Allman)

Found on kelp holdfasts.

Antenella avalonia (Torrey)

Taken in tow-net from floating red algæ.

Family CAMPANULARIIDÆ

Mention may be made here of one of the Campanulariidæ recently sent me by Professor Hilton of Pomona College, to whom thanks are due for many courtesies. It does not appear to be any species yet reported from this coast. Its identification, or at least an adequate description, must, however, be postponed for a future paper.

Summer School at Laguna Beach

During the six weeks of summer school of the past season (1914) there were in attendance about thirty students and investigators, some of whom remained until the middle of September. In addition to these there were several hundred visitors to the aquarium and laboratory, in spite of the bad condition of the roads. After the middle of the summer running salt water was piped to the laboratories and aquaria, so that it was much easier to keep specimens

LAGUNA LABORATORY

alive. Yet even before this many interesting forms were on exhibition. At all times there were numerous marine animals for study, as well as many living land species, such as tarantulas, lizards, frogs, a large turtle and a number of snakes. Several rattlesnakes were kept in a box in the front of the building until the end of the summer. Several of the largest rattlesnakes were an unending source

IN LAGUNA CANYON

SHORE NEAR SEAL ROCKS

of interest. One day several people were able to observe a king snake swallow a slightly smaller rattler.

From day to day a varied display of marine forms was to be found in the aquarium; at different times rare and curious fish, starfish, sea urchins and devilfish, while now and then some of the larger specimens, such as sharks and rays, were brought in. Some

A COVE ABOVE LAGUNA

of these were kept alive in the large cement floor tank or in the larger jars. Great quantities of smaller specimens were no less interesting, such as sea spiders, serpent stars of many beautiful colors and markings, brilliant nudibranchs, large abalones, curious small crabs and, in fact, all the interesting or beautiful specimens that could be found.

A VIEW FROM ONE OF THE SHORE CAVES

SEAL ROCKS IN THE DISTANCE

Each week, until September, the public was also invited to attend the evening lectures. These were usually of a general nature relating to the life of the sea, but some told of land forms as well, and one was on the Hopi Indian Snake Dance.

The chief work of the laboratory during the first six weeks was in connection with the Summer School. There was a class of nine in General Biology, twelve in General Zoology, and five in General

SHORE NEAR EMERALD BAY

Entomology. There were, in addition, from six to twelve doing special work for a longer or shorter period. Students from three Pacific coast colleges were in attendance, although most of the students and advanced workers were from Pomona College. Two or three studied special Histological or Embryological topics, but the majority were interested in faunal and distributional problems. As announced at an earlier time, the Laguna station is but an extension

of the Biological part of Pomona College, and the plan for special work includes a survey of the whole region from the mountains to the sea. With this in mind, many explorations have been begun, and the aid of specialists in various fields is sought, so that we may first of all know the living forms that inhabit this varied and interesting section of California. We hope that a better knowledge of the species in the different groups here may lead to more extensive observations both by advanced students from the College and by others.

THREE ARCHES BELOW LAGUNA

Together with the special and general work of the students, collections of marine and land animals were obtained all through the summer. Some of these were for the local collection, others to aid in the work of the survey. Among the collections made were many species of sponges, hydroids, polyzoans, pycnogonids, marine worms, Crustacea of several groups and, in fact, nearly all the shore forms that could be obtained between tides or a short distance from shore with a small boat. There were also extensive collections of insects and spiders from the hills and from up and down the coast.

For the study of marine and land animals Laguna has proved itself once more well adapted to our uses. The high hills come down near the ocean at several points, and there are miles of interesting and varied coast line in both directions from the laboratory. All summer, students in small or larger parties tramped over the hills and through the many interesting canyons to the lakes, to the Mission of San Juan Capistrano, or to Balboa and the mud flats. Saturday was the regular field day, and the longer tramping trips

SAN JUAN CAPISTRANO

were then taken, but very often of an evening groups of students enjoyed beach suppers or picnics in some canyon or up in the hills.

That Laguna and its surroundings is a region of great interest and beauty is evinced by the fact that a number of artists make it their home, while it is visited by many others. The trail to Balboa, along the beach or the cliffs, is wonderfully varied and beautiful,

while the drive from Laguna to San Juan Capistrano, except for the lack of villages and ruins, might well be considered a part of the famous Amalfi Sorrento drive in Italy.

During the summer of 1915 courses in general as well as special zoology will be given. General entomology may also be studied with advantage. For those who are just beginning biological work there may be special exercises arranged, as last summer.

There are eight private rooms in the laboratory for special workers. Some of these will be available for investigators who may wish to follow out problems of their own or those suggested by the work of the station. Write

W. A. Hilton, *Director,*
Pomona College, Claremont, California.

Wants and Exchanges

Subscribers and others are urged to use these columns to make their wants known. As the Journal goes to all parts of the world we hope to make this a very useful feature of the publication. Exchange notes are free to subscribers.

WANTED—Myriopods from all parts of the world. Will name, exchange or purchase. R. V. Chamberlin, Mu. Comp. Zoology, Harvard Univ., Cambridge, Mass.

Will exchange insects of any order from Southern California, for Microlepidoptera from any part of North America, preferably pinned, with complete data concerning capture. Fordyce Grinnell, Jr., Pasadena, Cal.

COCCIDÆ—California Coccidæ exchanged for specimens from all parts of the world. E. O. Essig, Secretary State Commission of Horticulture, Sacramento, Cal.

WANTED—Cephalopods (in alcohol); Chitons (in alcohol or dry); shells of West American Mollusca; zoological literature. Offered: West American and other molluscan shells; zoological pamphlets, mainly on the Mollusca. S. S. Berry, 502 Cajon St., Redlands, California.

California Syrphidæ, Aphididæ to exchange for non-California Syrphidæ. W. M. Davidson, Walnut Creek, Cal.

WANTED—For exchange, papers on marine and fresh-water Protozoa. Albert L. Barrows, Department of Zoology, University of California, Berkeley, Cal.

WANTED—Information on any mite-papers for sale or exchange that have an economic bearing. H. V. M. Hall, Room 8, Court House, San Diego, Cal.

WANTED—Specimens and separates relating to the pseudoscorpions, in exchange for local species. M. Moles, Claremont, Cal.

WANTED—Literature and determined specimens of Collembola, in exchange for local forms and literature. G. Bacon, Claremont, Cal.

WANTED—Determined specimens of Thysanura in exchange for local species. R. Gardner, Claremont, Cal.

WANTED—Separates relating to the nervous system and sense organs of the invertebrates in exchange for reprints by a number of authors on this and other topics relating to the anatomy of invertebrate animals. W. A. Hilton, Claremont, Cal.

Tabanidæ from all parts of North America to exchange for Tabanidæ from the Western United States and Mexico and Central America. Jas. G. Hine, Ohio State University, Columbus, Ohio.

Sarcophagidæ from all parts of the world bought or exchanged, according to arrangement. North American material determined. R. R. Parker, Ent. Lab., Mass. Agri. College, Amherst, Mass.

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